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Fruit Production Recommendations

Ministry of
Agriculture
and Food
ONTARIO
Jack Riddell, Minister
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POLICY STATEMENT

In this publication, most recommendations list several pesticides that are effective for each insect or disease discussed. Where possible, the less hazardous materials and those that growers have used satisfactorily for a number of years are listed first. These are followed by the more toxic pesticides and/or newer ones with which we have less experience. It must be emphasized that, in some cases, the most effective pesticides are highly toxic.

Weather and other factors influence the effectiveness of pesticides and the likelihood of plant injury by control chemicals. Consult the package label and other information regarding compatibility with other materials, the effect of high or low temperatures, poor drying conditions, etc. Wettable or soluble powder (WP or SP) preparations generally are less likely to cause plant injury than liquid concentrate (EC, SC, and F) formulations.

A number of brand names of pesticides are given in the calendars as a convenience to the fruit grower and are neither an endorsement of the product nor a suggestion that similar products are not effective.

Pesticide products listed in this publication have been reviewed by the Ontario Pesticides Advisory Committee and have been classified under the Pesticides Act.

The pesticide recommendations are revised annually by the Ontario Crop Protection Committee, which is composed of personnel of the Ontario Ministry of Agriculture and Food and of Agriculture Canada. **Old editions should be discarded**. Commercial fruit growers should consult Spray Service Circulars issued by the Horticultural Crop Advisors, Ontario Ministry of Agriculture and Food, for changes that may be recommended when additional information is available, or because of local outbreaks or unusual weather conditions. An agri-phone system is in operation during the growing season throughout most of the areas involved in horticultural production. Three-minute recorded messages, updated daily, provide timely information on pest development (see page 2).

Under certain conditions, fungicides and insecticides may cause plant injury. Read the precautions on the label and consult the manufacturer's information about compatibility before combining products in a spray mixture. See page 12. The pesticide recommendations are for commercial plantings. Home gardeners should use products recommended for home gardens.

ACKNOWLEDGMENTS

The recommendations contained in this publication have been prepared in consultation with:

- Ontario Crop Protection Committee
- Ontario Fruit Research Committee
- Ontario Weed Committee
- Ontario Soil Management Research Committee

and personnel of:

- Plant Industry Branch, Ontario Ministry of Agriculture and Food
- Agriculture Canada
- Ontario Agricultural College, University of Guelph
- Horticultural Research Institute of Ontario
- Kemptville College of Agricultural Technology
- Ontario Ministry of the Environment
- Ontario Ministry of Labour
- Health and Welfare Canada

† Temporary Registration of Pesticides

Temporary registration of a pesticide is a procedure which is frequently used prior to full registration. Temporary registration is only granted for a period of one calendar year. On December 31 of each year, the temporary registration status ceases. After that time period the pesticide may be discontinued, have the temporary registration extended or be granted full registration.

As of the printing date of this publication, the pesticides indicated with the (†) were registered on a temporary basis for use in 1985. The fate of these materials has not been fully determined for 1986. Growers are urged to check the registration status of these pesticides prior to use. If a pesticide is no longer registered it is no longer legal to use it. A pesticide should not be used on any crop unless it has been registered for that crop.

Pesticides with a temporary registration and listed in this publication in 1986 are:

1. **Belmark 300 EC**
2. **Decis 2.5 EC**
3. **Ridomil 240 EC**
4. **Ripcord 400 EC**

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ONTARIO MINISTRY OF AGRICULTURE AND FOOD

HORTICULTURAL CROP ADVISORS

Counties or Area Served	Name	Address	Phone No.
Eastern Ontario		College of Agricultural Technology Kemptville, K0G 1J0	613-258-3411
Prince Edward, Hastings, Lennox, Addington, Frontenac	Jody Bodnar	P.O. Box 470, Picton, K0K 2T0	613-476-3224
Northumberland, Peterborough	Dave Ridgway	P.O. Box 340, Trenton, K8V 5R5	613-392-3527
Durham, Victoria, Ontario	Bengt Schumacher	234 King Street East Bowmanville, L1C 1P5	416-623-3348
North York (Bradford Marsh Area)	Matt Valk*	Muck Research Station R.R. 1, Kettleby, L0G 1J0	416-775-3783
Simcoe, Dufferin, Grey	Ken Wilson	P.O. Box 69, Clarksburg, N0H 1J0	519-599-2042
Halton, Peel, Wellington, North Wentworth	Joe Uyenaka	17 Wilson Drive, Milton, L9T 3J7	416-878-2314
Niagara Peninsula	Burke McNeill Ian Smith	Vineland Station, L0R 2E0	416-562-4142
Norfolk, Brant	Steve Rowe	P.O. Box 587, Simcoe N3Y 4N5	519-426-7120
Oxford, Elgin, Perth, Waterloo	Keith Priest	P.O. Box 666, Woodstock, N4S 7Z5	519-537-6623
Lambton, Middlesex, Huron	John Gardner	60 King St., London, N6A 2P2	519-434-6811
Essex, Kent	Ed Tomecek	College of Agricultural Technology Ridgetown, N0P 2C0	519-674-5456
Essex, Kent	Clem Fisher Leslie Huffman	Research Station, Harrow, N0R 1G0	519-738-2251
Horticultural Crop Advisor (Potatoes)	Sam Squire	P.O. Box 370, Alliston, L0M 1A0	705-435-5521
Horticultural Crop Advisor (Greenhouse Flowers)	John Hughes	Dept. of Horticultural Science University of Guelph, N1G 2W1	519-824-4120 ext. 8910
Horticultural Crop Advisor (Flowers & Nursery)	Wayne Brown	Vineland Station, L0R 2E0	416-562-4142
Horticultural Crop Advisor (Marketing)	Bob Cobbledick	Vineland Station, L0R 2E0	416-562-4142

PEST MANAGEMENT SPECIALISTS

Durham and Counties Eastward	Cathy McKay	234 King St. East Bowmanville, L1C 1P5	416-623-3348
York (Muck Veg. Crops)	Mary Ruth McDonald	Muck Research Station RR#1 Kettleby, L0G 1J0	416-775-4261
Niagara Peninsula	Kevin Ker Gerald Walker	Vineland Station, L0R 2E0	416-562-4142
Halton County and westward including Oxford	Pam Fisher	P.O. Box 587, Simcoe N3Y 4N5	519-426-7120
Elgin County and westward including Essex	Alison Smith	60 King St., London, N6A 2P2	519-434-6811
Southern Ontario	Craig Hunter	P.O. Box 587, Simcoe, N3Y 4N5	519-426-7120

Agri-phone Numbers — for regularly up-dated recorded messages

Kingsville	519-733-3151	Simcoe	519-426-7810	Georgian Bay	519-599-2915
Chatham	519-352-0222	Milton	416-876-1383	Newmarket	416-775-3493
London	519-438-1014	Vineland	416-562-4345	Bowmanville	416-623-4944
Woodstock	519-537-7161	St. Catharines	416-684-6684	Smithfield	613-392-3422
				Kemptville	613-258-5836

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* *Horticultural Research Institute of Ontario staff.*

ONTARIO MINISTRY OF THE ENVIRONMENT - PESTICIDES CONTROL FIELD OFFICES

Counties	Field Offices	Telephone
Southwestern Region		
Elgin, Middlesex, Oxford	D.C. Morrow & W. Lampman 985 Adelaide Street South, London N6E 1V3	519-661-2200
Essex, Kent, Lambton	H.E. Collins P.O. Box 726, 435 Grand Ave. W. Chatham N7M 5L1	519-354-2150
Bruce Grey, Huron, Perth	B.T. Lobb 20 King Street P.O. Box 688, Ont. Ministry of Agr. & Food Bldg. Clinton N0M 1L0	519-482-3428
West Central Region		
Haldimand, Norfolk, Niagara, Hamilton, Wentworth	J. Percy Ont. Gov't. Bldg., 119 King St. W. Hamilton L8N 3Z9	416-521-7640
Dufferin, Wellington, Waterloo, Brant	R. Miller Ont. Gov't. Bldg., 119 King St. W. Hamilton L8N 3Z9	416-521-7640
Central Region		
Halton, Peel, York, Durham, Toronto	T. O'Neill & D. Trenholm 7 Overlea Blvd., Don Mills M4H 1A8	416-424-3000 (ext. 211)
Peterborough, Victoria, Haliburton, Northumberland	A.G. Carpentier 139 George Street N., Peterborough K9J 3G6	705-743-2972
Simcoe, Muskoka	W. Cowie 12 Fairview Road, Barrie L4N 4P3	705-726-1730
Southeastern Region		
Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville	D.A. Reddon 133 Dalton St., Kingston K7L 4X6	613-549-4000
Prescott & Russell, Renfrew, Stormont, Dundas & Glengarry, Ottawa-Carleton, Lanark	R.P. Cameron 2378 Holly Lane, Suite 204, Ottawa K1V 7P1	613-521-3450
Northwestern Region		
Kenora, Rainy River, Thunder Bay	G.R. Gammond Ontario Government Building, 435 James St. S., Thunder Bay P7C 5G6	807-475-1215
Northeastern Region		
Manitoulin, Nipissing, Parry Sound, Sudbury	D.J. Mewett Northgate Shopping Centre, 1500 Fisher St., North Bay P1B 2H3	705-476-1001
Cochrane, Timiskaming, Algoma	P. McCubbin 199 Larch St., Sudbury P3E 5P9	675-4501
Head Office		
	Agricultural and Industrial Chemicals Section 135 St. Clair Avenue W., Suite 100 Toronto, Ontario M4V 1M2	416-965-2401

PUBLICATIONS — The following publications are available from any of the Pesticide Control Field offices or from Agricultural & Industrial Chemicals Section, Suite 100, Ministry of the Environment, 135 St. Clair Ave. W., Toronto, Ontario M4V 1P5:

- Personal Protective Equipment for Pesticide Users
- Chemical Safety Handbook
- Pesticides Act and Regulations
- Chemical-Storage Signs

PRECAUTIONS WITH ALL PESTICIDES

1. Always read the label before opening pesticide containers and follow all precautions and directions.
2. Never smoke, chew tobacco or eat while handling or applying pesticides. DO NOT carry such items in clothes used for spraying.
3. Always wear neoprene gloves to handle the concentrate and when coming in contact with dilute spray i.e. cleaning nozzles, and pumps, and handling contaminated spray equipment.
4. Inhalation of spray droplets, dust or fumes should be avoided. Wear a respirator to reduce pesticide inhalation especially when handling dusty formulations or volatile concentrates. For gases, a self-contained breathing apparatus may be required.
5. Wear freshly laundered clothes each day, including caps. Regularly wash gloves and boots. Avoid spilling pesticides on skin or clothing.
6. Avoid contamination of water supplies, wells, ponds, streams, etc. with pesticides when filling or flushing spray equipment. Never fill a sprayer directly from a stream, pond or well unless the unit is equipped with an antiblackflow device to prevent siphoning.
7. Keep a record of the common names of all pesticides handled and especially those listed as hazardous (page 4) in this publication. This list should be known by members of your family in the event of an accident. You can use this book, see Table 18, page 72.

IF ACCIDENTS OCCUR

1. If an accident occurs, remove contaminated clothing including under clothes immediately, and wash contaminated skin thoroughly with soap and water. Wash all clothing including caps, gloves and boots before reuse.
2. When spraying, if clothing becomes wet with a pesticide, remove it immediately. When the spray operation is complete, remove all contaminated clothes including under clothes, have a bath or shower and put on freshly laundered clothing.
3. If symptoms of illness occur during or shortly after handling or applying a pesticide, get the patient to a hospital immediately. Take the list of common name chemicals on page 73 with you to the hospital (see Emergency Procedures for Pesticide Poisoning).
4. Clean up any pesticide spills immediately. Use dry soil or other absorbent material to remove excess liquid. If the spill is major, contact the nearest office of the Pesticide Control Service for advice. (See list page 3).
5. If a well becomes contaminated, follow clean-up instructions in OMAF Factsheet, Pesticide Contamination of Farm Water Supplies, Agdex 607.

FIRST-AID INFORMATION

The Occupational Health and Safety Division, Ministry of Labour, 400 University Avenue, Toronto, M7A 1T7, has physicians available for consultation on first-aid information and advice. They can be contacted:

Between 8:00 a.m. and 5:00 p.m. Monday to Friday. Telephone (416) 965-3610.

During weekends, public holidays and non-office hours. Telephone (416) 965-1211 and ask for the "on-call" physician.

EMERGENCY PROCEDURES FOR PESTICIDE POISONING

If a pesticide is spilled onto clothing or parts of the body remove clothing including under garments and wash skin and hair with water or soap and water if available. Flush eyes with plenty of water.

Should a person exhibit symptoms of poisoning such as weakness, slow heartbeat, incoordination, tremors, abdominal cramps, salivation, or blurred vision but is still conscious, seek medical help immediately by rushing the patient to the emergency ward of the nearest hospital. If the patient is unconscious call an ambulance.

Always know the common name of the chemical being used. Get this from the label or from the list below or use this book for reference.

RELATIVE HAZARD TO HUMANS OF PESTICIDES RECOMMENDED ON FRUIT CROPS

Extreme Hazard

Wear a chemical cartridge respirator with a dual chemical cartridge suitable for the pesticide to be used, see page 5, for protection against most pesticides. It is recommended for outside use against light concentration of pesticides. This type of respirator and cartridge should be used along with rubber or neoprene gloves, rubber boots and protective eyeshields when handling or mixing any of the pesticides listed below. It is also worn when applying extremely toxic or highly toxic compounds outdoors.

azinphos-methyl (Guthion, APM)
carbofuran (Furadan)
demeton (Systox)
dichlozopropene, methyl isothiocyanate (Vorlex)
methidathion (Supracide)
methomyl (Lannate)
mevinphos (Phosdrin)
oxamyl (Vydate)
paraquat (Gramoxone)
parathion
zinc phosphide

Moderate Hazard

These pesticides are dangerous through inhalation, skin contact or if taken by mouth. A few grams can be fatal. Always wear protective clothing when mixing or applying these chemicals (see page 6). Avoid mixing in windy areas and dispose of containers properly (see page 6). Always change clothing and wash up immediately after using these materials.

captan* (Captan, Orthocide)
cyhexatin (Plictran)
daminozide (Alar)
deltamethrin (Decis)
diazinon (Basudin)
dimethoate (Cygon 480E)
DNOC (Elgetol)
endosulfan (Thiodan)
phosmet (Imidan)
phosalone (Zolone)
pirimicarb (Pirimor)

These pesticides are dangerous if handled carelessly. Caution is required to insure that they are not taken internally or allowed to contact the skin. Wear protective clothing, including respirator and goggles, when mixing or working with them in confined areas. Avoid breathing the vapors. Triple rinse and dispose of containers properly page 6. Always change clothing and wash up immediately after using these materials.

**Current studies indicate that captan requires special handling procedures as outlined on the label. Read and follow directions closely.*

TABLE 1. SAFETY SUPPLY COMPANIES IN ONTARIO PROVIDING PROTECTIVE CLOTHING AND/OR RESPIRATORY DEVICES FOR OUTDOOR PROTECTION AGAINST CERTAIN PESTICIDES

Respiratory Devices Manufactured By	Available From
American Optical	AOCO Limited, Subsidiary of American Optical Corporation, 60 Mobile Drive, Toronto, M4A 2R7. Tel. (416) 752-8780 Branches: Hamilton & Belleville.
H.S. Cover (York)	Levitt-Safety Ltd., 33 Laird Drive, Toronto, M4G 3S9. Tel. (416) 425-8700 Branches: Kitchener, London, Ottawa, St. Catharines, Sarnia, Stoney Creek, Sudbury and Thunder Bay.
Kasco Helmets	The St. George Co., St. George, N0E 1N0. Tel. (519) 442-2046
Mine Safety Appliances	MSA Canada Inc., 148 Norfinch Drive, North York, M3N 1X8. Tel. (416) 667-9400
3M Occupational Health & Safety Products Div.	Safety Supply Canada, 214 King St. East, Toronto, M5A 1J8. Tel. (416) 364-3234 Branches: Hamilton, Kingston, Kitchener, London, Mississauga, St. Catharines, Sarnia, Scarborough, South Porcupine, Thunder Bay and Windsor.
North	Siebe-North Inc., 26 Dansk Court, Rexdale, M9W 5V8. Tel. (416) 675-2790
Racal Airstream	Safety Supply Canada, 214 King St. East, Toronto, M5A 1J8. Tel. (416) 364-3234 Branches: Hamilton, Kingston, Kichener, London, Mississauga, St. Catharines, Sarnia, Scarborough, South Porcupine, Thunder Bay and Windsor.
Safety House	Safety House of Canada Ltd., 1275 Castlefield Ave., Toronto, M6B 1G4. Tel. (416) 789-0631 Branches: Kitchener, London, Orillia, Ottawa, St. Catharines & Stoney Creek.
Scott	Safety Supply Canada, 214 King Street East, Toronto, M5A 1J8. Tel. (416) 364-3234 Branches: Hamilton, Kingston, Kitchener, London, Mississauga, St. Catharines, Sarnia, Scarborough, South Porcupine, Thunder Bay and Windsor
Survivair	Levitt-Safety Ltd., 33 Laird Drive, Toronto, M4G 3S9. Tel. (416) 425-8700 Branches: Kitchener, London, Ottawa, St. Catharines, Sarnia, Stoney Creek, Sudbury and Thunder Bay.
Willson	Safety Supply Canada, 214 King Street East, Toronto, M5A 1J8. Tel. (416) 364-3234 Branches: Hamilton, Kingston, Kitchener London, Mississauga, St. Catharines, Sarnia, Scarborough, South Porcupine, Thunder Bay and Windsor.

Many of the companies listed above have dealer outlets in addition to branch outlets. For details of dealer outlets contact the supply company of your choice.

Low Hazard

Pesticides listed in this calendar and not appearing on this list are less toxic, but should be handled with all precaution listed on the label. Even the most toxic pesticide can be used safely, if used properly, by following all directions and precautions listed on the label.

SPECIAL INSTRUCTIONS

It should be emphasized that all pesticides are toxic and must be handled carefully. In addition, there are major deficiencies in the toxicological information of a number of pesticides (insecticides, fungicides and herbicides) because of the many tests that were conducted by the Industrial Biotest Laboratory (IBT) that were invalid. Replacement studies are currently being conducted by the respective registrants. Those handling and applying these chemicals must pay special attention to the precautions outlined above.

At the time of printing this publication, pesticides included in the 1986 Fruit Production Recommendations requiring additional studies are as follows:

CSA COMMON NAME	TRADE NAME
captafol	Difolatan
endosulfan	Thiodan
folpet	Phaltan
formetanate hydrochloride	Carzol
methidathion	Supracide

BLOOD TESTS FOR THOSE APPLYING PESTICIDES

Organophosphorus and carbamate pesticides are capable of inactivating the serum and the red blood cholinesterase levels. If the activity of cholinesterase falls below a critical level, human poisoning can result as exhibited by fatigue, dizziness, nausea, trembling, blurred vision, difficulty in breathing and other symptoms.

For those working outdoors and applying these groups of pesticides, it is strongly recommended that cholinesterase levels be checked by your family doctor. To be of value the tests should be commenced prior to using these pesticides and not after applications have commenced, since the normal level per individual can vary considerably, making it difficult to assess the degree of suppression. In this publication the primary insecticides of concern are those listed as extremely and moderately hazardous to humans (see page 4).

Protective Clothing when using Pesticides Outdoors

1. It is recommended that neoprene or rubber gloves, rubber boots, a protective apron or coverall, and protective eyeshields be worn to reduce the risk of dermal exposure when measuring, mixing and loading pesticides.

   Protective clothing, including disposable gloves, aprons or overalls and hat covers, are available at reasonable prices from the major safety supply companies listed below.
2. Wash all clothing after use. Wear freshly laundered clothes each day.
3. Although recommended when loading and handling concentrates, the wearing of dual cartridge chemical respirators is neither mandatory nor required with all pesticides or under all conditions of pesticide use. If a label specifies respiratory protection, follow the directions closely. A wide range of respiratory devices for outdoor respiratory protection from certain pesticides is available from the major safety supply companies who offer both full and half-face models in varying sizes. Consult the safety supply company of your choice for appropriate guidance and selection. See page 5.

REENTRY TO TREATED AREAS

Pesticide poisoning may occur when workers enter fields too soon after pesticides have been applied. Such poisoning can result from handling treated plants or from inhalation of pesticide vapors.

The pesticides listed below are those for which a specific minimum interval must be observed from the time of application to the time of working in the crop. For some pesticides, e.g. parathion, the label carries a warning regarding working in treated crops. **Follow these recommendations.** Where no label warnings are provided, the following minimum intervals are recommended.

24 Hours	48 Hours	7 Days
Lannate (methomyl)	APM (azinphos-methyl)	Parathion
Phosdrin (mevinphos)	Guthion (azinphos-methyl)	
Supracide (methidathion)	Systox (demeton)	
Vydate (oxamyl)	Furadan (carbofuran)	

Storage

1. **General Storage:**
   The Ontario Pesticides Act and Regulation 751 require that all pesticides be kept out of the reach of children, irresponsible persons, pets and livestock. They should be stored in a locked facility away from food for humans, and feed for animals. Herbicides should be stored separately from other pesticides to avoid possible contamination.

   Special Storage:
   Schedule 1, 2 and 5 pesticides must be stored in a storage facility which is ventilated to the outside atmosphere. A placard bearing the words "**Chemical Storage Warning - Authorized Persons Only**" in block capitals must be affixed to the outside of each entrance. Entry to the storage facility should only be made by the person responsible for the pesticide, or with his permission.
2. **Always store pesticides in original containers and keep them tightly closed. Never put pesticides in unmarked containers.** See also OMAF Factsheet, *Farm Storage of Pesticides,* Agdex 607.
3. Post pesticide storage areas with proper notices.
4. In areas where flooding has been a frequent occurrence, fertilizers and pesticides must be stored above the known high water mark to void contamination of the flood waters. Contamination of water by these chemicals can and has led to serious health problems, affecting humans, domestic animals as well as fish and wildlife.

Disposal of Pesticide Containers and Contaminated Material

1. Containers from pesticide packages, and any paper or other material used to clean up spills, should be buried or burned. Make sure that people and animals are kept away from the smoke, and that the smoke is not directed toward buildings, highways, roads, or outdoor public areas.

2. Un-rinsed containers can contain as much as 3% of the original formulation. If this amount of toxic pesticide is discarded with the drum it could be dangerous to other people handling it, or to the environment (for example, your water supply). Failure to rinse is also wasteful — why not use that 3% for the purpose for which it was purchased, i.e., to control the pest!

Rinse all empty metal or glass containers three times with water and add washings to the spray tank. Or, use a rinsing device. These rinsers can be used to puncture the bottom of a metal or plastic drum, and to rinse the residual left in the container directly into the spray tank. This procedure takes less than a minute and results in a rinsed container. The rinsed containers may be crushed, buried and covered by at least 50 cm of soil, away from any watercourse or water table.

PESTICIDE DRIFT

Pesticide drift can leave unwanted residues on adjacent crops, be a hazard to people and livestock nearby, or reduce the amount of material in the target area so that it is ineffective. Those applying pesticides should make every effort to minimize or prevent pesticide spray drift by paying attention to:

1. correct calibration and maintenance of spray equipment
2. correct operation of the equipment
3. the toxicity of the pesticide in use
4. the weather conditions

For more information consult OMAF Factsheet, *Pesticide Drift,* Agdex 607 or Canadex 607, *Pesticides: Effects of Drift and Droplet Size.*

AIRCRAFT APPLICATION

Aerial applicators must be licensed by the Ontario Ministry of the Environment to apply pesticides. In addition, permits are required from the Ontario Ministry of the Environment under the authority of The Pesticides Act 1973 for the application of Schedule 1 and 5 pesticides, and Schedule 2 hormone-type herbicides. The area will be inspected by Ministry personnel to ensure safety of application.

It is an offense under the Federal Pest Control Product Act to use a control product under unsafe conditions. Precautionary practices must be heeded at all times to prevent drift. Extra precautions should be taken when using insecticides applied by air, especially those known to be toxic to honeybees, e.g. Sevin (carbaryl).

Applications should not be made if the wind is blowing. Some drift occurs even on the stillest day. To keep drift to a minimum, apply pesticides in the evening or early morning.

Be sure that the product to be used and its rate of application are specified in the contract.

PESTICIDE INJURY TO CROPS

Although insecticides and fungicides have been selected and formulated to avoid plant injury, damage can still occur under some conditions. In addition to the precautions mentioned in this publication, there are a number of other precautions which should be observed:

1. Apply sprays when the drying condition is fast. Some chemicals break down to components which are injurious to plant tissues if they are permitted to stay wet.
2. Apply sprays when the temperature is below 27°C. The spray deposits serve as a lens and concentrate the heat on the plant tissues.
3. Be particularly careful when plants have been under growth stress such as prolonged periods of drought, excessive cloud cover, extremely low or high temperatures.
4. Apply sprays soon after mixing. Undesired chemical change may take place with some chemicals if the sprays remain in the tank for prolonged lengths of time, e.g. overnight. In other cases, the chemicals may settle out and clog the lines.

PEST RESISTANCE TO INSECTICIDES, FUNGICIDES AND MITICIDES

Pests are said to be resistant when they are able to survive exposure to rates of pesticides that previously controlled them. Generally, resistance in a pest population develops after repeated exposure to a specific chemical. A few naturally occurring resistant individuals survive after each spray, while the sensitive portion of the population is controlled. These resistant survivors multiply and gradually make up the majority of the population, resulting in a control failure.

The development of resistance to pesticides with a single mechanism of action can occur very quickly. These chemicals should not be used repeatedly during a growing season. They should be alternated or used in combination with other pesticides having different modes of action in order to reduce the likelihood of resistance developing.

You should be aware that several pesticides with different names have the same mechanism of action. For example, Benlate and Easout act on the same site in the fungus. This means that resistance develops to both of these chemicals at the same time, even though only one may have been used repeatedly. The same is true for the many synthetic pyrethroid compounds, as well as for Cyprex and Equal; Plictran and Torque.

INSECTICIDES

Synthetic pyrethroids — Tentiform leaf miner has become resistant to Ambush, Belmark and Decis in several orchards in Ontario. The repeated use of this pesticide family is not encouraged because it reduces the number of beneficial insects and also results in the development of resistance.

It is feared that resistance will build-up in the Pear Psylla population if the synthetic pyrethroids are used more than once per season.

Lannate — Several cases of Tentiform leaf miner resistance to Lannate have been documented in Norfolk County.

FUNGICIDES

If you experience a control failure with a well timed fungicide application, you should consider the possibility of resistance by the pest organism.

Benlate/Easout — Cases of resistant apple scab have been documented in most of the apple growing areas of the Province. Resistance to Benlate has also been documented for brown rot on peaches and cherries, as well as for **Botrytis** on strawberries and grapes.

Cyprex/Equal — Apple scab has developed resistance to these identical chemicals in a moderate percentage of orchards in most of the apple growing areas of the Province. Resistance to Cyprex/Equal is persistant for many years once it is established in an orchard, and these chemicals cannot be used effectively.

Rovral — **Botrytis**, the causal agent of bunch rot of grapes, has developed resistance in many vineyards after 4 years of use. Resistance is expected to develop to grey mould in strawberry fields as well. However, the resistant form of the fungus does not survive well, and declines when Rovral is not used for several years.

If Rovral is only used once or twice per season, but not consecutively, resistance should remain at low levels and Rovral should remain effective.

Test of the brown rot organism on cherries and peaches have indicated no resistant populations to date.

MITICIDES

Plictran — Some low level resistance of European Red Mite to Plictran has been confirmed in 25% of the 45 apple orchards tested in 1984. It should be noted that Torque has the same mode of action as Plictran and is not recommended as an alternative miticide. Data shows that repeated use of Plictran will result in widespread control failures.

Kelthane — European Red Mite resistance to Kelthane was widespread in the late 1960's and a survey in 1984 indicated that it was present in 4% of the apple orchards tested. Resistance to Kelthane is not stable and if the chemical is not used for 3 - 5 years, the population will gradually loose its resistance. However, if the chemical is used repeatedly, resistance is expected to return quite quickly.

USE OF FUNGINEX

Funginex is a fungicide representing a new family of chemicals — the sterol inhibitors. They control a fungus in a way different from older materials such as captan. Funginex has the ability to enter the fruit or blossom tissue and be taken up by the fungus mycelium. Once in the fungus it interferes with the sterol synthesis system eventually killing the fungus before it can show up on the fruit surface, or produce spores for further spread. Because it acts on the mycelium, rather than on the germination of the spore, Funginex has somewhat less "protective" action than captan, but has longer 'curative' action. Since it attacks mycelium, it can be applied at, or just after an infection, with equally good results. Application after wet weather will give better control than will other materials, but application several days prior to wet weather will be less effective than with a "regular" protectant.

INTEGRATED PEST MANAGEMENT

Much has been said in recent years about integrated pest management and reduced use of pesticides. In Ontario, integrated pest management has been a part of the pest control program. While it is not possible at this time to include a complete integrated pest management program in the recommendations, significant progress has been made and growers are urged to take advantage of the additional information.

THE CONCEPT

In the late 1960s, it became apparent that total reliance on chemical pesticides for pest control was not a good practice. A decision was made to move as quickly as possible to more efficient use of pesticides in Ontario agriculture. The concept of integrated pest control was adopted. This involves all possible methods of pest control, including various horticultural practices, to maintain pests at low levels so that they do not cause economic damage.

In Ontario, the first major program of integrated pest management was developed with the peach crop. Success in that area has permitted expansion into other crops. Presently, much of the progress in pest management has been due to effective methods of monitoring for pests so that treatments are applied only when needed. Pest management programs are now available on apples, grapes and peaches in the areas of the province with concentrations of these crops.

The programs have provided good control at reduced costs because of a reduced number of spray treatments and reduced dosages of pesticides.

WHAT IS INVOLVED

The keys to successful integrated pest management are: selecting tolerant varieties for new plantings; practicing good sanitation by removing wild hosts that may carry pests; and using sound cultural practices and applying treatments with a properly functioning sprayer. The use of sex pheromones and other attractants by which specific insects can be drawn into traps has been a major development in improving our ability to determine when pests are present and at what levels sprays must be applied.

In addition, pest management includes proper selection of pesticides and dosage rate so that minimum damage is done to beneficial parasites and predators. Spray applications are then timed to critical stages in the development of the pest. There is, thus, an intensive involvement of the Horticultural Crop Advisor, Pest Management Specialist, and the grower working as a team to arrive at the best control practice. This is not a program on which farmers can embark on their own. Rather, they should be in regular contact with the Horticultural Crop Advisor or Pest Management Specialist to develop and carry out their program.

How to Get Information

The extension service of the Ontario Ministry of Agriculture and Food has developed a network of Agri-phones (page 2) that will provide for specific areas data on weather, including a five-day forecast, horticultural advice, the status of insect and disease pests, and general information of value to the grower in planning the crop production program. Agri-phones are not available in all areas and it is important that the grower check with the Horticultural Crop Advisor (page 2) to determine if the information needed for a pest management program is available in the area, and how to get involved in the program.

In order to make pest monitoring and advisory services more available to growers, local Pest Management Specialists have been provided to work with Horticultural Crop Advisors in Ontario.

POLLINATION

Pollination is essential for the production of most fruits. Many growers provide for this by arranging to have beekeepers move honeybee colonies into the crop during the blooming period. The following suggestions may help in utilizing the services of honeybees more efficiently for this purpose:

1. Obtain honeybees from a reliable beekeeper who is able to supply strong, healthy colonies. Weak colonies are of little value for early spring pollination when cool weather is often encountered.
2. Two to three colonies of honeybees per hectare should provide satisfactory pollination for most fruits. In young orchards fewer bees may be required. However, because of the unfavorable weather frequently encountered during the time when the earlier-blooming apricots, cherries and plums are in blossom, the grower may be

well-advised to use more bees per hectare. For use with pollen inserts, five colonies per hectare are suggested.

3. Set out the colonies after the blossoms have partially opened (earlier for sweet cherries). This will encourage a greater number of bees to work on the fruit blossoms in the surrounding orchard rather than to forage elsewhere. This consideration is extremely important for the effective use of pollen inserts.
4. Since cool weather is often encountered during fruit bloom, encourage maximum honeybee flight by giving the colonies some protection from cold spring winds. Place the colonies in small groups in sunny, sheltered locations. Where no natural windbreak is available, it is wise to erect a temporary wind shelter. Bales of straw are quite satisfactory for this purpose. Try to place the colonies so that the morning sunshine will strike the hive entrances.

NOTE: Pollination cannot be expected to produce results in orchards that are suffering from nutritional deficiencies, insect or disease problems, poor drainage, or other adverse conditions. Do not expect greatly improved crops from the use of bees and pollen inserts until such deficiencies have been corrected.

A pollen insert is a device that can be inserted into the entrance to a honeybee colony in such a way that bees leaving the hive are forced to crawl through a shallow tray containing pollen from the desired pollenizer. Sufficient pollen will usually adhere to the legs and body of each foraging bee to enable it to cross-pollinate the blossoms it visits. For additional information on the use of pollen inserts, consult the Horticultural Crop Advisor serving your area, or the Department of Environmental Biology, University of Guelph.

REDUCE BEE POISONING

Bees are essential for the pollination of most tree and small fruits. Insecticides, many of which kill bees, are required for insect control. With careful management, you can obtain both pollination and insect control. You can protect the bees by following these suggestions:

1. **Do not apply insecticides while tree fruits are in bloom. The "Bees Act" makes it an offence to do so in Ontario.**
2. Remove honeybee colonies as soon as pollination is complete and before any postbloom insecticides are applied.
3. Time of treatment is important. In general, daytime treatments, when bees are foraging in the field, are most hazardous. Insecticide applications in the very early morning or evening are safest.
4. If there is a risk of honeybee poisoning, try to choose an insecticide that is not highly toxic to the bees (use pesticide rating, page 9).
5. Honeybees frequently are poisoned by visiting cover crops, such as dandelions or clovers, that are in bloom in the orchard. Clipping or beating down such crops prior to spraying will help safeguard the bees.

Extremely Toxic to Bees — Sevin

This insecticide has caused more loss (confirmed cases of poisoning) to bees than any of the other materials listed below. Fruit growers and apiarists require close liaison where this material is applied.

The following groups (chemicals used with fruit crops) show the relative toxicity of pesticides to honeybees as determined by laboratory and field tests in California.

Group I — Pesticides Highly Toxic to Bees

Severe losses may be expected if the following materials are used when bees are present at treatment time or within a few days thereafter:

Ambush
APM
Belmark
Cygon
Decis
diazinon
Furadan
Guthion
Imidan
malathion
parathion
Phosdrin
Sevin
Supracide
Vydate

Group II — Pesticides Moderately Toxic to Bees

These can be used around bees if dosage, timing, and method of application are correct, but should not be applied directly on bees, in the field or at the colonies:

Carzol
Lannate
Pirimor
Systox
Thiodan
Zolone

Group III — Pesticides Relatively Non-Toxic to Bees

Benlate
captan
Cyprex
Difolatan
Easout
ethion
Equal
ferbam
Karathane
Kelthane
methoxychlor
Omite
phygon
Plictran
Polyram
Sayfos
sulfur
zineb

GUIDE FOR SPRAYING TREE FRUITS

The procedures for efficient use of orchard sprayers are contained in Publication 373, Orchard Sprayers. Though this information was derived mostly from apple orchards, the general principles of spray information, and the operation and maintenance of equipment apply equally well to spraying of peaches, pears, plums and cherries. The following points should be stressed:

1. The sprayer must be large enough to cover the orchard in the time available and under adverse conditions.
2. Equipment must be in top condition.
3. Trees must be pruned so that the spray will penetrate easily.
4. Regular checks must be kept on severity of disease, insect pest numbers and stages, and lengths of wetting periods, so that timing will be accurate.
5. The rate of pesticide and the volume of water required will vary depending upon the individual situation. The rates in the spray calendar are based on spraying trees 4.5-5.5m in height. Trees larger or smaller *MAY* require more or less pesticide. See Table A. As well, the volume of water required to spray the tree will vary because of application equipment, tree size, and target pest. The original so-called "Dilute" rate was based on spraying a standard tree to run-off. For trees 4.5-5.5m, this is now considered to be 3,000 L/ha. Again, this volume can be adjusted up or down depending upon tree size. See Table A. Many growers successfully adjust rate of pesticide/ha by changing the volume they apply, either by cutting off certain nozzles, or by changing driving speed. This allows greater flexibility in farms with various-sized trees, while maintaining the same amount of chemical put in each full tank of water.

NOTE: Companies are not liable for failure due to use of rates below those recommended on their labels.

TABLE A

Tree Height	Pesticide/ha	Water/ha for Dilute Spraying
6m and over	1-1/3 × recommended rate	4000 L
4.5-5.5m	full recommended rate	3000 L
2.5-3m	2/3 × recommended rate	2000 L

6. Both low volume applications and low rates of chemical have resulted in increased populations of scales, mites and woolly aphid, especially in treetops.

   For oil sprays, enough spray liquid must be used to soak the bark completely. When spraying streptomycin for fireblight, higher volumes are also required for maximum absorption of material. Suggested volumes are below.

TABLE B

Water Volumes for Special Pests

Trees 6m and over — 4500 L water/ha
Trees 4.5-5.5m — 4000 L water/ha
Trees 2.5-3m — 3500 L water/ha

Calibrating the Sprayer

See page 24 of Publication 373, or follow this shortened version.

Refer to Table 2 on driving time per hectare.

Table 2. SPRAYING TIME PER HECTARE (Without turning & filling time)

Distance between rows (metres)	Tractor Speeds km/hr 1.6	2.4	3.2	4.0	4.8	5.6	6.4
			Time in Minutes to Drive One Hectare				
3.0	125.0	82.5	62.5	50.0	41.25	35.0	31.0
4.6	82.5	55.0	41.25	33.0	27.5	23.5	20.5
6.1	62.5	41.25	31.0	25.0	20.5	17.75	15.5
7.6	50.0	33.0	25.0	20.0	16.5	14.0	12.5
9.1	41.25	27.5	20.5	16.5	13.75	11.75	10.25
10.7	35.25	23.5	17.75	14.0	11.75	10.0	8.75
12.2	31.0	20.5	15.5	12.5	10.25	9.5	7.75

Proceed through the following seven steps:

1. Check tractor speed:

Table 3. TIME REQUIRED TO PASS A NUMBER OF TREES AT DIFFERENT DRIVING SPEEDS

Tractor Speed km/h	IN THE ROW TREE SPACINGS (Metres) 6.1	7.6	9.1	10.0	10.7	12.2
	Time (Seconds) to Pass 10 Trees					
2.4	91	114	136	150	159	182
3.2	68	85	102	112	119	136
4.0	54	68	82	90	95	109
4.8	45	58	70	77	82	94
5.6	39	49	58	64	68	78
6.4	34	43	51	56	60	68

2. Make a sprayer-tank measuring stick marked off in units of 50L.
3. From the chart find the number of minutes needed to spray a hectare at the speed recommended for your sprayer.
4. Decide how many litres of liquid per hectare you wish to use (considering time available, size of sprayer, size of trees, and time of day spraying will be done).
5. Find the sprayer output required thus:

   $$\frac{\text{litres per hectare}}{\text{time per hectare}} = \text{litres per minute (for all nozzles)}$$

6. Divide this output by the number of nozzles:

   $$\frac{\text{litres per minute}}{\text{number of nozzles}} = \text{litres per minute per nozzle}$$

7. From manufacturer's chart* find a nozzle to give this output. Then choose nozzles with smaller outputs for top and bottom positions and larger ones for the upper third of each side. When added, the total output should be close to the value shown in No. 5 (L per min). For small trees, block off one or two of the top nozzles and shut off between trees to prevent waste of spray.

   ** Pages 40-47, Publication 373, Orchard Sprayers.*

ABBREVIATIONS

ai = active ingredient
AP = agricultural powder
DP = dispersable powder
E = emulsifiable
EC = emulsifiable concentrate
F = flowable
e.g. = for example
Gr = granules, granular
% = percent (by weight)
SC = sprayable concentrate
SP = sprayable powder
W = wettable
WP = wettable powder

mm = millimetre
cm = centimetre
m = metre
km = kilometre
cm^2 = square centimetre
m^2 = square metre
ha = hectare
mL = millilitre
L = litre
g = gram
kg = kilogram
t = tonne
kPa = kilopascal
m/s = metres per second
km/h = kilometres per hour

METRIC CONVERSIONS FOR CONCENTRATE SPRAYING OF ORCHARDS

TANK SIZE		Acres sprayed with 1 tank at 3 rates: in gal/acre			Hectares sprayed with 1 tank at 3 rates: in L/ha		
GALLONS	**LITRES**	**20 gal/ac**	**60 gal/ac**	**100 gal/ac**	**225 L/ha**	**670 L/ha**	**1120 L/ha**
100	455	5.0	1.7	1.0	2.0	0.67	0.40
160	730	8.0	2.7	1.6	3.2	1.0	0.65
200	910	10.0	3.3	2.0	4.0	1.3	0.81
240	1090	12.0	4.0	2.4	4.8	1.6	0.97
300	1365	15.0	5.0	3.0	6.0	2.0	1.2
400	1800	20.0	6.7	4.0	8.0	2.7	1.6
500	2275	25.0	8.3	5.0	10.0	3.4	2.0

EXAMPLE

Tank size — 300 gal — 1365 L
Spraying rate — 60 gal/acre — 670 L/ha

Imperial Recommendations

Ambush 12 oz/acre
Polyram 6 lb/acre

Amount required per tank:
Ambush 12 × 5.0 = 60 oz ÷ 16 = 3.75 lb
Polyram 6 × 5.0 = 30 lb

To convert kg to lb multiply by 2.2
1.7 kg × 2.2 = 3.74 lb
13.5 kg × 2.2 = 29.7 lb

Metric Recommendations

Ambush 850 g/ha
Polyram 6.75 kg/ha

Amount required per tank:
Ambush 850 g × 2.0 = 1700 g = 1.7 kg
Polyram 6.75 kg × 2.0 = 13.5 kg

Table 4. PHYSICAL COMPATIBILITY OF SPRAY MATERIALS

Where a blank appears on the chart, the materials can be used together.

☐ — Compatible
X — Do not use together
• — Not recommended together in this calendar
? — Compatibility unknown
OP — Organo-phosphorus compound

Do not mix pesticides with Streptomycin, thinning sprays or foliar fertilizers.

The chart applies only to the use of two material spray combinations for deciduous fruit. **When three or more materials are tank-mixed together, further incompatibility may develop.**

Compatibilities of some materials may depend upon solvents and emulsifiers used by the manufacturer. Emulsifiable concentrate formulations are more likely to cause compatibility problems than wettable powders. **If wettable powders are mixed with emulsifiable concentrates, incompatibilities may result.**

Do not allow spray mixtures to sit overnight.

	Agri-Mycin 17	Ambush	**APM**	Belmark	Benlate	Benlate + Captan	Benlate + Manzate	**Benlate + Polyram**	Bordeaux	Botran	Captan	Carzol	**Cygon**	Cyprex, Equal	Decis	Diazinon	Dichlone	**Difolatan**	Dikar	Dithane M-45	DNOC (Elgetol)	Easout	**Easout + Captan**	Ferbam	Furadan	Guthion	Imidan	**Karathane**	Kelthane	Lannate	Malathion	Manzate 200	**Methoxychlor**	Morestan	Omite	Parathion	Phaltan	**Phosdrin**	Phygon XL	Pirimor	Plictran	Polyram	**Pounce**	Ripcord	Rotenone	Rovral	Sevin	**Sulfur**	Superior Oil	Supracide	Systox	Thiodan	**Vydate**	Zineb
Agri-Mycin 17																																																						
Ambush	•																																																					
APM	•	•																																																				
Belmark	•	•	•																																																			
Benlate	•																																																					
Benlate + Captan	•				•																																																	
Benlate + Manzate	•				•	•																																																
Benlate + Polyram	•				•	•	•																																															
Bordeaux	•	X	X	X	X	X	X	X																																														
Botran	•					•	X	X	X																																													
Captan	•	10	7	10			•	•	1																																													
Carzol	•						?	?	?	?																																												
Cygon	•	?			4	?	?	?	X	X		?																																										
Cyprex, Equal	•					•	•	•	X																																													
Decis	•	•	•	•	?	X	?	?	•	?	X		•	?																																								
Diazinon	•	•	•						X	7					•																																							
Dichlone	•	X		X		•	•	•	X	•		?	X		X	7																																						
Difolatan	•		•		•	•	•	•	•	•	•		•	•	?	•	•																																					
Dikar	•				•	•	•	•	•		•							•																																				
Dithane M-45	•								•	X						9		•	•																																			
DNOC (Elgetol)	•	•	•		•	•	•	•	X	•	X	•	•	•	•	•	X	•	•	•																																		
Easout	•				11	•	•	•	X				4		?			•	•		•																																	
Easout + Captan	•				•	•	•	•	X	•			?		X		•	•	•		•	•																																
Ferbam	•	?	4	?		•	•	•	X	•					?			•			•		•																															
Furadan	•	•	•	?		•	•	•	•	•		?	•	?	•	•	•	•	•	•	•		•	•																														
Guthion	•	•	11	•					X		7				•	•	7	•			•			4	•																													
Imidan	•	•	•	•					X						•	•	•	•	2		•				•	•																												
Karathane	•	?		?	•	•	•	•	•	•		?	4		?			•			X	•	•		•																													
Kelthane	•			?					X		7	•		4	?		7	•			•				?			7																										
Lannate	•	?		•					X	•		?			?		?	•			•				•		•																											
Malathion	•	•							X	7		?	•		•		7	•		9	•				•		•																											
Manzate 200	•								X	X						9		•	•	11	•				•						9																							
Methoxychlor	•	•		•								?			•			•		7	•				•		•					7																						
Morestan	•		•	?		•	•	•	•	•		?	•		?	•	•	•			•		•	•	•	•	•	•	•	•	•		•																					
Omite	•			?					X			•	?		?			•			•				•				•	•				•																				
Parathion	•	•	•	•					3				•		•		X	•			•				•		•	4	•					•																				
Phaltan	•	?	7	?		•	•	•	1		11				X			•	•		X		•			7			7																									
Phosdrin	•	•	•	•					X	X		?	•		•			•	?		•				•		•							•																				
Phygon XL	•	X		X		•	•	•	X	•		?	X		X	7		•			X		•		•	7	•		7	?	7			•		X																		
Pirimor	•			?					•	?		?	?	?	?	?	?		?		?			?	?			X	?	?	?		?	?	?	?		?	?															
Plictran	•								•			•	•		?			•			•				•				•	?				•	•			?		?														
Polyram	•					•	•	•	•	X						9		•	•	11	•		•		•						9	11	?																					
Pounce	•	11		•		?	?	?	?		10	?			•		X	•	?	?	?		?	?			?				?		?			?			X	?														
Ripcord	•	•	•	•	?	?	?	?	•	?	?	?	•	?	•	•	?	?	?	?	•	?	?		•	•	•	?	?	?	•	?	•	?	?	•	?	•	?	?	?	?	•											
Rotenone	•	?		?	•	•	•	•	X	?		?	•		?			?			•	•	•		•																		?	?										
Rovral	•			•		•	•	•	•	•		X	•	•	?	?	•	•		•	•		•	?	•			?	•	•	•	•	•	•	•	X		•	•	•	•	•	?	?	•									
Sevin	•	•		•					X						•			•			•				•									•				•					?	•		•								
Sulfur	•	?		?	•	X	•	•			1	?		8	?			•			X	•	X		•			•		X				•			1			?			?	?										
Superior Oil	•					1				•	1	?	X	5	?		1	1	X		X		1		X			X	•	•			X	X	X		1		1	?	•		?	?		•	?	X						
Supracide	•	?	?	?					?	?		?	?	X	?	?	X				?				?	?	?			?	?		?		?	?		?	X	?	?		?	?	?	•	?							
Systox	•	?		?					X	7		?	•	X	?		X	•			•				•									•		•			X	?			?	?		•								
Thiodan	•	?	•	?					X		7	?	•		?	•	7	•			•				•									•			7		7	?				?		?			6					
Vydate	•			?					X						?			•			•			?																			?	?	•	•			X	•				
Zineb	•					•	•	•	•	X						9		•	•	11	•		•		•						9	11	7									11		?		•								
Zolone	•	•	•	?	2				X	9			•		?			•			•	2			•	•				•			•							?			?	?	•	?			?	?				

1. Should not be used with or within 14 days of oil application.
2. May cause injury on grapes.
3. Residual action reduced.
4. May cause injury under some weather conditions.
5. Consult manufacturer regarding suitable oil for combination to be used on apple. Do not use it later than half-inch green stage (see page 14).
6. Use EC formulations.
7. Use WP formulations.
8. Combination may cause necrotic spotting on Delicious.
9. Apply immediately with agitation.
10. When mixing captan with EC formulations of pyrethroids, add captan first. Apply immediately with constant agitation.
11. Chemically similar materials.

Table 5. NUMBER OF DAYS FROM LAST SPRAY TO HARVEST

Read the Label and Follow all Safety Precautions

Canada's Department of National Health and Welfare has established amounts of insecticides and fungicides that may remain on fruits at time of harvest. To avoid exceeding these tolerances, use recommended amounts and do not spray nearer to harvest than number of days shown below, or not later than stage indicated. This is subject to change by Information Letter as additional information is available. For tank mixes of two or more materials, use the longest time period given for any of the materials.

Do not apply a pesticide more often than recommended on the label.

— pesticide not recommended in this calendar on this crop
X no tolerance for pesticide on that fruit
D dormant only
DD delayed dormant, half-inch green
PB prebloom
PH postharvest
C not later than recommended in calendar
OP organo-phosphate

		Apple	Pear	Cherry	Peach and Nectarine	Plum	Grape	Black berry Rasp-berry	Straw-berry	Apricot	Currant and Goose-berry
Ambush		7	7	—	7	—	21	—	—	—	—
APM	OP	7	7	15	21	—	28	—	—	—	—
Belmark		60	60	X—	X—	X—	X—	X—	X—	—	—
Benlate		1	1	1	1	1	7	1	1	1	—
Botran		—	—	—	1	—	—	—	—	—	—
captan		7	7	2*	2	2	7	2	2	2	—
captan-benomyl		7	—	—	2	2	—	—	—	2	—
Carzol		1	1	—	—	—	—	—	—	—	—
Cygon 480E	OP	14	14	15	40	X—	X—	X—	XC	—	—
Cyprex		7	7	7	—	X—	X—	X—	7	—	—
Decis		1	7	—	7	—	—	—	—	—	—
diazinon	OP	14	14—	10	20—	10	16	X—	5—	—	—
Dichlone		1	X—	3	shuck split	3C	X—	X—	—	—	—
Difolatan		DD	—	—	D	—	—	—	—	—	—
Dikar		30	30	—	—	—	30	—	—	—	—
Dithane M-45		30	30	X—	X—	X—	30	X—	X—	X—	X—
DNOC (Elgetol)		XD—	XD	XD—	XD—	XD—	XDD	X—	—	XD	—
Dyrene		—	—	—	—	—	—	—	5	—	—
Easout		1	—	1	1	1	—	1	1	—	—
Equal		7	7	7	—	X—	X—	X—	7	—	—
ethion	OP	30	30	—	30	30	30—	—	8	15	—
ferbam		7	7—	4	21	7—	7	XC	—	21	14
Funginex		—	—	C	C	C	—	—	—	—	—
Furadan		—	—	—	—	—	—	—	XC	—	—
Guthion	OP	7	7	15	21	15	28	7	5	21	—
Imidan	OP	1	1	7	1	1	7	X—	X—	—	—
Karathane		21	21	X—	X—	X—	30	X—	X—	—	—
Kelthane		7	7	7	14	7	7—	7	2	14	—
Lannate		8	—	—	—	—	—	—	—	—	—
Malathion	OP	3	—	3	7—	3	3—	1	3	7	3
Manzate 200		30	30	X—	X—	X—	30	X—	X—	—	—
methoxychlor		7—	7—	7	21	7	14—	—	14	21	14
Morestan		PB	PB	PB—	PB—	PB—	X—	X—	X—	PB—	—
Omite		7	PH	PH	14	28	28	—	3	—	—
parathion	OP	14	14	14	14	14	14—	—	14	14	—
Phaltan		1	X—	1	X—	X—	1	—	1	—	7
Phosdrin	OP	2—	2—	3	3	3	5—	3	1	—	—
Phygon-XL		1	X—	3	shuck split	3C	X—	X—	—	—	—
Pirimor		35	—	—	—	—	—	—	—	—	—
Plictran		14	14	—	7	—	—	—	7	—	—
Polyram		7	X—	—	X—	X—	45	X—	X—	—	—
Pounce		7	7	—	—	—	—	—	—	—	—
Ridomil		XC	—	—	—	—	—	XC	XC	—	—
Ripcord		7	7	—	—	—	—	—	—	—	—
rotenone		—	—	—	—	—	—	1	—	—	—
Rovral		—	—	1	1	—	7	—	1	—	—

Continued on Page 14

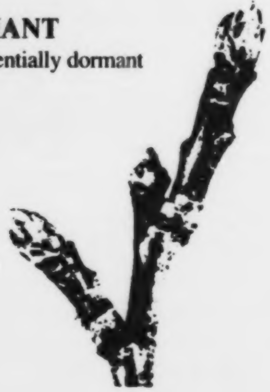
TABLE 5 (Continued)

		Apple	Pear	Cherry	Peach and Nectarine	Plum	Grape	Black berry Rasp-berry	Straw-berry	Apricot	Currant and Goose-berry
Sevin		7	7	1	1	1—	3	—	2—	3	—
Streptomycin sulfate		50	30	—	—	—	—	—	—	—	—
Sulfur		1	1	1	1	1	1**	—	—	1	1
Supracide		XC	—	—	—	—	—	—	—	—	—
Systox	OP	21	21—	—	30—	60—	21—	PH	21—	—	—
Thiodan		15	15	15	15	15	30	X—	7	—	—
zineb		14	7	30	—	30—	30	14—	7—	—	7
Zolone	OP	1	7	7	7	14	14	—	—	—	—

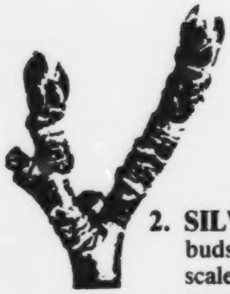
** 5 days on Sour Cherry* *** 21 days on wine grapes*

FIGURE 1. APPLE BUD STAGES

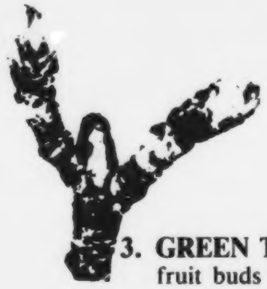
The naming is based on recommendations by Dr. P.J. Chapman of the New York State Agricultural Experiment Station, Geneva, New York.



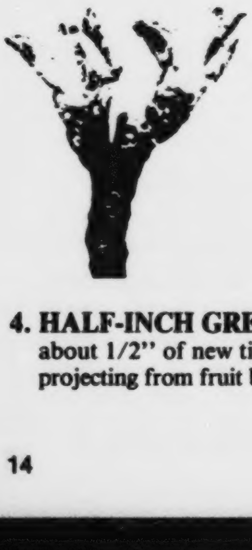
1. DORMANT
buds essentially dormant



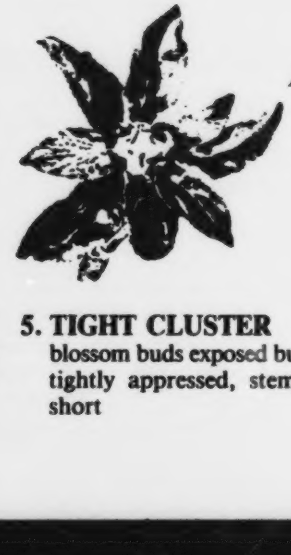
2. SILVER TIP
buds swollen and bud scales separated to expose some light gray tissue at tips



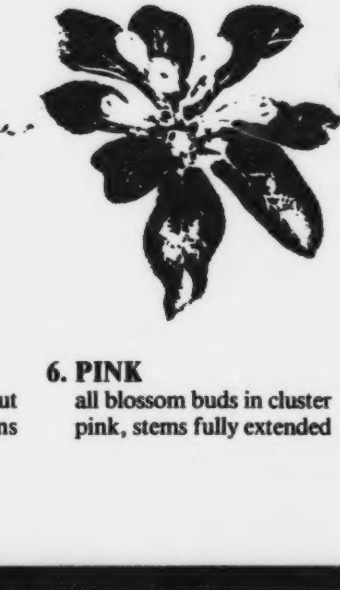
3. GREEN TIP
fruit buds broken at tips and showing about 1/16" green



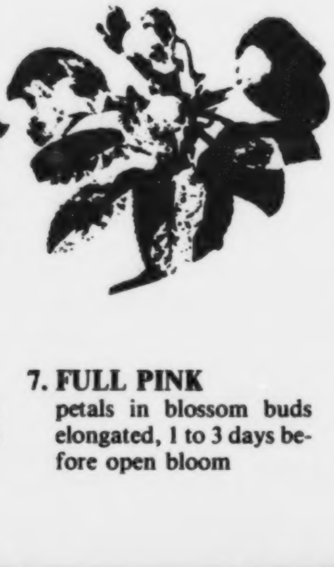
4. HALF-INCH GREEN
about 1/2" of new tissue projecting from fruit buds



5. TIGHT CLUSTER
blossom buds exposed but tightly appressed, stems short



6. PINK
all blossom buds in cluster pink, stems fully extended



7. FULL PINK
petals in blossom buds elongated, 1 to 3 days before open bloom

Table 6. RELATIONSHIP OF TEMPERATURE AND MOISTURE TO APPLE SCAB INFECTION*

Mean Temperature °C	Hours of Wetting for Infection Primary	Secondary
26	13	9
24	9	6
22	9	6
20	9	6
18	9	6
16	9	6
14	10	7
12	12	8
11	13	9
10	14	9
9	15	10
8	17	11
7	22	15
6	25	17
5	34	23
1-4	48 +	32 +

* *Adapted after Mills.*

Table 7. RETENTION, REDISTRIBUTION AND AFTER-INFECTION ("ERADICANT") ACTIVITY OF SOME FUNGICIDES FOR CONTROL OF PRIMARY APPLE SCAB (ASCOSPORE STAGE ONLY)*

	Maximum After-infection Activity				
Materials	6°C	12°C	17°C	Retention	Redistribution
Benlate 50 WP (0.5 kg)	48 hr	24 hr	18 hr	Poor-fair	Unknown
Captan 50 WP (2 kg)	48 hr	24 hr	18 hr	Poor-fair	Fair-good
Cyprex 65 WP (0.5 kg)	48 hr	24 hr	18 hr	Good	Good
Dikar WP (2 kg)	48 hr	24 hr	18 hr	Good	Good
Dithane M-45 80 WP (2 kg)	48 hr	24 hr	18 hr	Good	Good
Equal 65 WP (0.5 kg)	48 hr	24 hr	18 hr	Good	Good
Manzate 200 (2 kg)	48 hr	24 hr	18 hr	Good	Good
Phygon 50 WP (0.5 kg)	96 hr	48 hr	36 hr	Poor-fair	Poor-fair
Polyram 80 WP (2 kg)	48 hr	24 hr	18 hr	Good	Good

* *Adapted after New York (Geneva) data. These values were obtained from greenhouse tests; rates quotes are per 1000 L. Rate per hectare is 3 times rate per 1000 L. The after-infection activity of these fungicides may not be adequate to control primary apple scab in a commercial orchard. Be very careful and don't rely heavily on the after-infection activity if the maximum time interval for a given temperature is being reached. The after-infection activity is calculated from the start of the wetting period.*

FUNGICIDE PROGRAMMES FOR APPLE SCAB CONTROL

Apple scab control spray programmes must begin when the first susceptible green tissue emerges from the buds in the spring. Mature ascospores will be present at that time, and will be ready to shoot off from the previous year's leaves on the ground to infect the newly emerging tissue. Infections will take place on the new foliage in the spring each time we get a wetting period of sufficient duration. The length of the wetting period necessary is dependent upon temperature. This relationship is outlined in Table 6.

Programmes for apple scab control are based primarily upon timing and the type of fungicide being used. There are three general approaches.

I. Protectant Programme

The basis for this programme is the application and maintenance of fungicide material on the expanding foliage prior to the occurrence of infection periods. The programme should commence just prior to the first primary infection period (between silver tip and green tip). Apply fungicides at 5-7 day intervals up to First Cover, preferably just prior to each primary infection period. From First Cover until early August, apply fungicides at 10-14 day intervals depending on rainfall frequency. New growth must be protected and residues washed off by rain must be replaced.

Some fungicides such as Polyram and Cyprex are not readily washed off and the residues are redistributed by rain water.

II. Difolatan Single Application Technique (SAT)

For prolonged scab control in the early season a high rate of the protectant fungicide, Difolatan, is applied between Green Tip and Half-inch Green, before an infection has occurred. Difolatan sticks tightly to twig surfaces, but enough is redistributed by rain water onto developing leaves to protect them from infection during subsequent rainy periods.

Protection may last through Pink to Petal Fall, however, under unreasonably wet or dry conditions, a follow-up fungicide programme may be required to commence at Full Pink. Normally, follow up fungicides are necessary from Petal Fall onward.

III. After-Infection ("Eradication")

An after-infection spray is one that is applied within a specific time after the infection period has begun. The length of time available to apply the fungicide effectively, depends on the product being used and the average temperature. See Table 7. When calculating after-infection activity, you must start counting the time interval at the **beginning** of the wetting period. For example, at 6°C you would have to apply Captan within 48 hours of the **beginning** of the wetting period.

After-infection fungicide programmes should not be relied upon entirely to control scab. In order to use this type of spray programme successfully, you need spray equipment capable of providing good spray coverage under adverse conditions, as well as, accurate temperature and leaf wetness information for your individual orchard.

Eradicant sprays are usually considered as emergency treatments when the regular protectant programme has been weak or ineffective.

Deactivation Of Established Scab Lesions

Apple scab lesions that are visible on the foliage and fruit contain many spores capable of further spreading the disease through secondary infection. The fungicides, Benlate and Cyprex have demonstrated good anti-sporulant activity except where resistance is present (See Page 7). It is possible to determine the presence of resistant apple scab by testing a sample of the infected foliage or fruit. Contact your Hort Crop Advisor or Pest Management Specialist to see if a Testing Service is available.

If resistant scab organisms are not present in your orchard (and apple scab lesions are visible) you can try to de-activate these infections.

Two sprays of Benlate or Cyprex should be applied at full rate 5-7 days apart, as soon as scab lesions are observed. These materials reduce the number of spores produced in the lesions and should help to slow the spread of the disease. These "eradicant" sprays should be followed up by a regular protectant programme.

Apple Scab Control Under Adverse Weather Conditions

Several consecutive days of continuous wet conditions and mild temperatures are common in the spring and are very favourable for apple scab infection to take place. It is often difficult to maintain sufficient fungicide material to provide protection for the rapidly expanding foliage and fruit under such conditions.

It is better to apply a fungicide during a break in the rain, or even during a light rain, than not to spray at all, if you feel your trees are not protected. A fungicide having good retentive properties should be used at such times. For example, Polyram has good retention and after-infection activity, while Benlate has good after-infection activity but poor retention when applied to wet trees.

After-infection sprays may be required when protectant fungicides become too diluted to prevent the apple scab fungus from establishing itself on the foliage or fruit. If the time limit for the after-infection activity (kick-back) of the fungicide (Table 7) is exceeded it may still be worthwhile applying the fungicide. Benlate can have anti-sporulant activity beyond the stated "After-infection Activity" period in Table 7. Repeat the application in 4 or 5 days if wet weather persists.

If an infection has occurred, lesions should become visible on the foliage and fruit in about 12 days at 20°C, and about 2-3 weeks if temperatures are 10-13°C, or lower. As soon as infections are visible, they should be controlled by following the instructions outlined in the section above entitled "Deactivation of Established Scab Lesions".

Strong winds can hamper spraying operations causing pesticides to drift away from the intended target. Lowering the spray trajectory into the wind may also help. Spraying at night, or the early morning, can help because frequently it is less windy after sunset or before mid-morning.

Determining Infection Periods

In spring, ascospores of the apple scab fungus infect developing leaves and fruit. It takes about three weeks for these early infections to appear as spots (lesions). These spots are covered by "summer spores" (conidia) which will cause secondary infection. Secondary infections will occur in only two-thirds of the wetting time necessary for ascospore (primary) infections. Infection will occur only if moisture is present for a long enough period of time. The length of the wetting period necessary for infection is dependent on temperature. **To tell whether or not an "infection period" occurred, note the time from the start of a rain to the time the foliage dries.** This is the wet perod. Calculate the mean temperature for this wet period.

Periods of dew will also contribute to a wet period. However, this is only significant if preceded by rain. The rain is necessary to initiate the infection period. If rain occurs at 5 p.m. and the leaves remain wet all night with dew, the total period for the infection period is calculated from the 5 p.m. rain until the dew dries the following morning. If dew occurs at 11 p.m. and rain occurs at 6 a.m. while the leaves are still wet, the infection period is calculated starting at 6 a.m. until the leaves are dry. Calculate the mean temperature for the wet period starting at the beginning of the initial rainfall.

If, for example, the wet period is 11 hours and the mean temperature during this wet period is 13°C, a light primary infection and/or a moderately severe secondary infection have occurred. (See Table 6.) The longer the wet period over the minimum required for infection, the greater will be the severity of the infection. Wet periods during intermittent rain should be added together to determine an infection period, unless separated by 10 hours or more of dry sunny weather.

Before applying an after-infection fungicide, check the after-infection activity of the fungicide. If the after-infection activity is 24 hours at 12°C (see Table 7), then the fungicide can be applied anytime during the 12 hours (24 hours - 12 hours of wetting at 10°C = 12 hours) following the end of the infection period, provided any temperature change is negligible. A fungicide having a 48-hour after-infection activity at 12°C can be used during the 36 hours (48-12 hours = 36 hours) following the end of the infection period.

FIRE BLIGHT CONTROL

Fire blight is a major problem for the grower of pears and susceptible apples in Ontario. Apple blossoms are affected most years; however, the most serious losses occur when branches and scaffold limbs of apple and pear are destroyed, reducing future fruit production potential. A number of practices are required in order to reduce blossom blight on apples, and shoot blight on both apples and pears.

If warm temperatures (18°C+) and rainfall occur during bloom, spray with 100 ppm streptomycin sulfate.* Repeat this spray if the wet condition persists. Spraying should be carried out under slow drying conditions (e.g. at night) for best results. Spraying following periods of rainfall and after hail injury can reduce shoot infections during the growing season (after petal fall). Caution is advised to ensure a 30-day to harvest interval on pear and 50-day to harvest on apple.

All diseased wood should be pruned out in the dormant season. New infections may be removed in the growing season, but this is not always practicable. Cut or break out infections at least 45 cm below any discolored wood. Disinfect any tools with one part Javex in four parts water. Store in a closed plastic or glass container. Wash tools and oil them to prevent rust. Denatured alcohol is a better disinfectant than the Javex solution and will not rust tools.

Insect pests such as aphids, psylla, leafhoppers and plant bugs should be controlled as they may transmit fire blight through their sucking and other activities in the orchard.

In a non-bearing orchard, Bordeaux (3-5-1000) may be substituted for streptomycin. However, it is less effective in its control of the disease.

It must be remembered that *all* these control methods should be carried out for best results in keeping fire blight to a manageable level in the orchard.

* *Agri Mycin 17-100 ppm = 600 g product/1000 L water*

PHYTOPHTHORA COLLAR ROT CONTROL

Collar rot problems have been experienced in several situations where heavy soil, poor drainage, or replanting of old sites occurs. This disease, caused by a long-lived soil-borne fungus *(Phythophthora cactorum)*, is especially damaging to trees grown on M106 and M9 rootstocks. Trees on M26 and M111 rootstocks are intermediate in susceptibility, and M7a is moderately resistant. Where concern for collar rot is present before planting, do not use susceptible rootstocks.

For problem areas, Ridomil 240E is registered for use on NON-BEARING trees only. Apply Ridomil 240E as a drench to the soil around the base of the tree. Use 4.25 ml in 5 L of water per tree. Make the first application at planting and repeat in late August. In subsequent non-bearing years, apply Ridomil 240E in the early spring and again in late August. This treatment will suppress fungal growth and development. However, the fungus will survive in the soil. Long-term control should include resistant rootstocks and proper site selection.

BORDEAUX MIXTURE

Bordeaux Formulas: In any Bordeaux formula, the numbers refer to kilograms of ingredient and any amount of water, and are always given in the same order, with the copper sulfate first, then the lime, and the water last (eg. Bordeaux 5-5-1000 L means 5 kg of copper sulfate and 5 kg of lime in 1000 L of water).

Make Tank-Mix Bordeaux:

1. Start water flowing into the spray tank.
2. When the tank is about one-third full and the mechanical agitator is in operation, start washing the powdered copper sulphate into the tank through a screen with water from the supply hose. A wooden spoon is often helpful in working powdered copper sulphate through the screen.
3. By the time the tank is two-thirds full, all of the powdered copper sulphate should be in the tank. Then wash the lime (hydrated or builders') through the screen, using the water-supply hose, into the copper sulphate solution in the tank. The lime should be as dilute as possible before it meets the copper sulphate solution in the tank, so use lots of water to wash lime through the screen. Pre-soaking the lime before adding to the tank may be preferred to washing powdered lime directly through the screen into the tank.
4. Keep the agitator running continuously and apply the Bordeaux Mixture immediately. Do not allow the mixture to settle out.

APPLES

For trees more than 5.5 m or less than 4.5 m high, adjust rates as indicated on page 9 Guide for Spraying.

Read the label and follow all safety precautions. **For dilute spraying refer to page 9, "GUIDE FOR SPRAYING TREE FRUITS"**

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	NOTES
GREEN TIP up to HALF-INCH GREEN	Scab Protectants			Consult Horticultural Crop Advisor for stage of spore development. Apply fungicide before spore release and keep growing leaves coated.
	Use one of:			
	single application technique OR	Difolatan 480 Flowable	45 L	For protection until petal fall (see page 15). Do not prune after application.
	Group A	(1) Polyram 80 W	6.75 kg	It is generally advisable to alternate materials in a spray program.
		(2) captan 50% WP	6.75 kg	
		or captan 80% WP	4.25 kg	
		(3) Phygon-XL 50% WP	850 g	Do not apply Phygon or Dichlone for 5 days after frost injury, or if there is any danger of frost. Consult label.
		or Dichlone 50% WP	850 g	
		(4) Dikar WP	6.75 kg	When used in a full season program, Dikar at 6.75 kg/ha will suppress orchard mites. Higher water volumes aid in mite suppression.
		(5) Manzate 200	6.75 kg	Manzate 200 and Dithane M-45 may cause fruit injury on Golden Delicious.
		(6) Dithane M-45 80% WP	6.75 kg	
	After-infection Spray ("Eradicants")	Use one of:		For after-infection activity, see Table 7, page 15 Do not apply Phygon or Dichlone for 5 days after frost injury or if there is any danger of frost.
		(1) Phygon-XL 50% WP	1.75 kg	
		or Dichlone 50% WP	1.75 kg	
		(2) Polyram 80 W	6.75 kg	
		(3) captan 50% WP	6.75 kg	
		or captan 80% WP	4.25 kg	
		(4) Dikar WP	6.75 kg	
	Red Mite Lecanium scale San Jose scale European fruit scale Rosy aphid	superior oil (60-70 vis.)	65 L OR 35 + 35 L	Best scale control up until greentip, best mite control from half-inch green to tight cluster. Apply full rate of oil in 2200-4500 L of water per hectare, 4500 L will give best results. Do not apply full rate of oil more than once per season. Test the stability of the emulsion by shaking in a jar. Apply 35 L of oil per hectare twice before pink stage. **On large standard trees, use 90 L or 45 + 45 L.**
	Red Mite	superior oil concentrate	17 L	**For Red Mite only.** For compatibility with other chemicals consult label.

OIL MAY CAUSE BARK INJURY ON RED DELICIOUS, EMPIRE AND MUTSU

	Rosy aphid	Pirimor 50 WP	1.7 kg	
	Scab	With superior oil or superior oil concentrate use one of: (1) Polyram 80 W (2) Dithane M-45 80% WP	 6.75 kg 6.75 kg	Add fungicide to tank when 1/4 to 1/2 full of water and mix thoroughly. Add superior oil last when tank is at least 3/4 full of water. Dithane M-45 may cause fruit injury on Golden Delicious.
	Powdery mildew	Use one of: (1) Dikar WP (2) Karathane WD 18.25% WP (3) Easout 70% WP (4) Benlate 50% WP plus Polyram 80 W (5) Benlate 50% WP plus captan 50% WP (6) Benlate 50% WP plus Manzate 200 (7) Sulfur 90-95% WP	 8.4 kg 3.5 kg 1.5 kg 1.1 kg 3.25 kg(6.75) 1.1 kg 3.25 kg(6.75) 1.1 kg 3.25 kg(6.75) 10.0 kg	Where mildew is a problem on varieties such as Idared, Jonathan, Cortland, and Tolman Sweet, spray at weekly intervals from bud burst until the terminal buds are formed (usually at 2nd cover). Materials (2), (3) and (7) must be used with one of the fungicides in Group A above for scab control. For scab control with mixtures (4), (5), and (6) use the higher rates in brackets Do not use sulfur on Delicious.
TIGHT CLUSTER PINK	Tentiform leaf miner	*(1) Ambush 500 EC or Pounce 384 EC †*(2) Belmark 300 EC †*(3) Decis 2.5 EC †*(4) Ripcord 400 EC	400 mL 520 mL 450 mL 500 mL 250 mL	Apply thorough spray coverage on truck and scaffold limbs. Consult agri-phone for timing. This treatment will also control early spring-feeding caterpillars and tarnished plant bug. Further treatments with Lannate may be required during the season because the leafminer is now resistant to Guthion, Imidan and Zolone. Consult Horticultural Crop Advisor.
	Scab	Use one of scab protectant fungicides listed in Green Tip except Difolatan. See page 16 for "adverse weather conditions."		
	Cedar apple rust Quince rust	Use one of: (1) ferbam 76% WP (2) Dikar WP (3) Polyram 80 W (4) Dithane M-45 80% WP	 2.5 kg 6.75 kg 6.75 kg 6.75 kg	In each spray up to and including FIRST COVER spray. Polyram and Dithane are not registered for quince rust.
	Fire blight	Agri-Mycin 17 100 ppm	600 g/1000L	High volume spraying preferrable. Use alone for best results. Also see page 16.
	Plant bugs	Use one of: (1) Cygon 480 E (2) [1]Supracide 250 EC	 2.5 L 6.7 L	Where troublesome, add to one spray before bloom. Will also control spring-feeding caterpillars and green fruitworm.

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[1] *Minimum period before reentry is 24 hours.*

[2] *Minimum period before reentry is 48 hours.*

[3] *Minimum period before reentry is 7 days.*

* *Repeated applications of synthetic pyrethroids are discouraged. See "Pesticide Resistance", page 7.*

† *See "Temporary Registration of Pesticides" inside front cover.*

APPLES (Continued)

For trees more than 5.5 m or less than 4.5 m high, adjust rates as indicated on page 9 Guide for Spraying.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	NOTES
	Spring-feeding caterpillars Green fruit-worm	Use one of: (1) [2]Guthion 50% WP or [2]APM 50 W (2) Zolone 30% WP (3) [1]Supracide 250 EC	 2.1 kg 2.1 kg 3.25 kg 6.25 L	This spray is not necessary if a synthetic pyrethroid was applied for tentiform leaf miner.
FULL PINK	Scab	Use one of scab protectant fungicides listed in Green Tip except Difolatan. See page 16 for "adverse weather conditions."		
	Red Mite	Use one of: (1) Morestan 25% WP (2) Carzol 92 SP (3) Plictran 50 W (4) Kelthane AP-35	 2.25 kg 1.1 kg 1.25 kg 4.5 kg	Miticides are most effective when used alone. Consult the agriphone for stage of mite development. Alternate miticides. Morestan aids in powdery mildew control. Do not use Morestan if oil was used later than HALF-INCH GREEN. Carzol is harsh on beneficial mite species and bees. Application before **PETAL FALL** is preferred.
IN ORCHARDS WHERE KELTHANE HAS BEEN USED FOR MANY YEARS (4-5 YEARS) EUROPEAN RED MITE HAS BECOME RESISTANT. ALSO IN A FEW ORCHARDS RED MITES ARE SHOWING SOME RESISTANCE TO PLICTRAN.				
	Rosy aphid	Use one of: (1) [2]Systox 240 SC (2) Cygon 480 E (3) Zolone 30% WP (4) Pirimor 50 WP (5) [1]Supracide 250 EC	 3.25 L 4.25 L 3.25 kg 1.7 kg 6.25 L	See note on bee toxicity, page 9.
BLOOM PERIOD	Scab	**DO NOT APPLY INSECTICIDES WHILE APPLE TREES ARE IN BLOOM.** See page 9. Use one of protectant fungicides listed in Green Tip except Difolatan. See page 16 for "adverse weather conditions." Do not apply Phygon or Dichlone at the full eradicant rate (1.75 kg/ha) during bloom.		
	POLLINATION	**Most varieties are commercially self-unfruitful and require mixed variety plantings and insects for cross-pollination. Honeybees find apple blossoms attractive. See also page 9. Remove bees before applying CALYX spray.**		
CALYX When most petals have fallen	Scab	Use one of the fungicides recommended in the GREEN TIP to HALF-INCH GREEN stage (except Phygon, Dichlone and Difolatan)		
	Tentiform leaf miner	[1]Lannate L	6.75 L	For tentiform leaf miner, control when the mines become visible on undersurface of initial leaves. Do not apply to Early McIntosh or Wealthy apple varieties.

	Mullein leaf bug	Use one of: (1) diazinon 50% WP †*(2) Belmark 300 EC (3) [1]Lannate L *(4) Ambush 500 EC or Pounce 384 EC	 3.25 kg 450 mL 6.75 L 400 mL 520 mL	Timing is critical. Spray immediately when nymphs are observed.
	Oyster shell scale	Use one of: (1) [2]Guthion 50% WP (2) [1]Supracide 250 EC	 2.1 kg 6.25 L	Apply as soon as petals are off.
	Plum curculio Caterpillars	Use one of: (1) [2]Guthion 50% WP or [2]APM 50 W (2) Imidan 50% WP (3) Zolone 30% WP *(4) Ambush 500 EC or Pounce 384 EC †*(5) Belmark 300 EC †*(6) Ripcord 400 EC	 2.1 kg 2.1 kg 4.25 kg 5.0 kg 400 mL 520 mL 450 mL 250 mL	
FIRST COVER 7 to 10 days after CALYX	Scab	See page 16 for "adverse weather conditions." Use one of the fungicides recommended in Green Tip except Difolatan, Phygon and Dichlone.		An extra scab spray may be required between **CALYX** and **FIRST COVER** spray.
	Plum curculio	Use one of the insecticides listed under CALYX		
	Red Mite Two-spotted Spider Mite	Use one of: (1) Plictran 50 W (2) Kelthane AP-35 (3) Carzol 92 SP	 1.25 kg 4.5 kg 1.1 kg	If this was your first mite spray a repeat application with an alternate miticide may be necessary in 7 to 10 days. Miticides are best used alone. Carzol is harsh on beneficial mite species and bees.

IN ORCHARDS WHERE KELTHANE HAS BEEN USED FOR MANY YEARS (4-5 YEARS) EUROPEAN RED MITE HAS BECOME RESISTANT. ALSO IN A FEW ORCHARDS RED MITES ARE SHOWING SOME RESISTANCE TO PLICTRAN.

SECOND COVER 10 days later	Scab	Use one of the fungicides recommended in Green Tip except Difolatan, Phygon, and Dichlone.		
	Codling moth	Use one of: (1) Imidan 50% WP (2) [2]Guthion 50% WP [2]APM 50 W (3) Zolone 30% WP (4) Sevin 50% WP or Sevin 85% WP	 4.25 kg 2.1 kg 2.1 kg 3.25 kg 3.25 kg 2.0 kg	Guthion and APM also control scale crawlers. Zolone also controls aphids.

(Continued on Page 22)

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[1] *Minimum period before reentry is 24 hours.*

[2] *Minimum period before reentry is 48 hours.*

* *Repeated applications of synthetic pyrethroids are discouraged. See "Pesticide Resistance", page 7.*

† *See "Temporary Registration of Pesticides" inside front cover.*

APPLES (Continued)

For trees more than 5.5 m or less than 4.5 m high, adjust rates as indicated on page 9 Guide for Spraying.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	NOTES
SECOND COVER **10 days later** (Continued)				
		*(5) Ambush 500 EC	400 mL	
		or Pounce 384 EC	520 mL	
		†*(6) Belmark 300 EC	350 mL	
		†*(7) Ripcord 400 EC	250 mL	
	Green Apple Aphid	Add one if aphids are abundant:		Diazinon, Cygon and Zolone will also control codling moth.
		(1) Pirimor 50 WP	1.7 kg	Pirimor will also control white apple leafhopper.
		(2) [2]Systox 240 SC	2 L	
		(3) Cygon 480 E	4.25 L	
		(4) Thiodan 50% WP	3.25-4.5 kg	Thiodan may also control white apple leafhopper. Check the label for recommended rate.
		(5) diazinon 50% WP	3.25 kg	
		(6) Zolone 30% WP	3.25 kg	Zolone will also control woolly apple aphid.
THIRD COVER **10 days later**	Scab Group A	Use one of:		
		(1) Polyram 80 W	6.75 (5.0 kg)	If scab is controlled in your orchard use the lower rate given in brackets.
		(2) captan 50% WP	6.75 (3.25 kg)	
		or captan 80% WP	4.25 (2.25 kg)	
		(3) Dikar WP	6.75 (5.0 kg)	
		(4) Manzate 200	6.75 (5.0 kg)	Manzate 200 and Dithane M-45 may cause fruit injury to Golden Delicious
		(5) Dithane M-45 80% WP	6.75 (5.0 kg)	
	Codling moth apple maggot	Use one of:		
		(1) Imidan 50% WP	4.25 kg	
		(2) [2]Guthion 50% WP	2.1 kg	
		or [2]APM 50 W	2.1 kg	
		(3) Zolone 30% WP	5.0 kg	
		(4) Cygon 480 E	4.25 L	Cygon is for processing apples only.
		(5) Sevin 50% WP	6.75 kg	
		or Sevin 85% WP	4.25 kg	
		(6) diazinon 50% WP	3.25 kg	
		*(7) Ambush 500 EC	400 mL	
		or Pounce 384 EC	520 mL	
		†*(8) Belmark 300 EC	350 mL	
		†*(9) Ripcord 400 EC	250 mL	
	DO NOT SPRAY CLOSER TO HARVEST THAN THE NUMBER OF DAYS GIVEN IN TABLE 5.			
	Green apple aphid	**See under SECOND COVER.**		

FOURTH COVER **10 days later**	Scab	Use one of the fungicides recommended for **THIRD COVER.**		
	Codling moth apple maggot	Use one of the insecticides recommended for **THIRD COVER**. Cygon is for processing apples only. For early apple varieties observe the days to harvest interval (see Table 5.)		
FIFTH COVER **10 days later**	Scab	Use one of the fungicides recommended for **THIRD COVER.**		
	Codling moth apple maggot	Use one of:		
		(1) Imidan 50% WP	4.25 kg	
		(2) [2]Guthion 50% WP	2.1 kg	
		or [2]APM 50 W	2.1 kg	
		(3) Zolone 30% WP	5.0 kg	
		(4) Sevin 50% WP	6.75 kg	
		or Sevin 85% WP	4.25 kg	
		(5) diazinon 50% WP	3.25 kg	
		*(6) Ambush 500 EC	400 mL	
		or Pounce 384 EC	520 mL	
		†*(7) Ripcord 400 EC	250 mL	
SIXTH COVER **10 days later**	Scab	Use one of the fungicides recommended for **THIRD COVER.**		
	Codling moth apple maggot	Use one of the insecticides recommended for **FIFTH COVER.**		
	Sooty blotch and fly speck	Use one of:		
		(1) captan 50% WP	6.75 kg	Repeat application of captan in two weeks.
		or captan 80% WP	4.25 kg	
		(2) Benlate 50% WP	625 g	Both captan and Benlate will control Bull's Eye Rot. All materials provide some protection agains other storage rots.
		plus captan 50% WP	3.25 kg	
		(3) Zineb 80% WP	4.25 kg	
		(4) Phaltan 50% WP	6.75 kg	
SEVENTH COVER Check on timing	Pinpoint scab and storage scab	Use one of the fungicides recommended for **THIRD COVER.**		Do not use fungicides closer than the stated preharvest interval.
	Second brood codling moth and apple maggot	Use one of the insecticides recommended for **FIFTH COVER.**		

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[2] Minimum period before reentry is 48 hours.

** Repeated applications of synthetic pyrethroids are discouraged. See "Pesticide Resistance", page 7.*

† See "Temporary Registration of Pesticides" inside front cover.

APPLES (Continued)

For trees more than 5.5 m or less than 4.5 m high, adjust rates as indicated on page 9 Guide for Spraying.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	NOTES
SPECIAL SPRAYS	White apple leafhopper	Use one of: (1) Pirimor 50 WP (2) Carzol 92 SP (3) Sevin 50% WP or Sevin 85% WP	 1.7 kg 1.1 kg 3.25 kg 2.0 kg	Spray when large numbers of nymphs (2-5 per leaf) are observed. Control of adults is very difficult.
	Bud moth Red-banded leafroller	Use one of: (1) [2]Guthion 50% WP or [2]APM 50 W (2) Imidan 50% WP (3) [3]parathion 15% WP	 2.1 kg 2.1 kg 4.25 kg 5.0 kg	See above for codling moth and apple maggot control. Do not use parathion on McIntosh, Cortland, Empire and Melba.
	Woolly apple aphid	Use one of: (1) malathion 25% WP (2) Zolone 30% WP (3) Pirimor 50 WP	 6.75 kg 3.25 kg 1.7 kg	High volumes of water are recommended. Spray coverage of trunk and scaffold limbs is essential. Repeat application in 14 days if woolly apple aphid is still present. Zolone is effective only if it is used in cover spray program. Pirimor will also control white apple leafhopper.
	Red mite Two-spotted mite Rust mite	Use one of: (1) Plictran 50 W (2) Kelthane AP-35 or Kelthane 187.5 EC (3) Carzol 92 SP (4) Omite 30 W	 1.25 kg 4.5 kg 8.5 L 1.1 kg 5.5 kg	Miticides are best used alone. Alternate miticides. Carzol is harsh on beneficial mite species.
IN ORCHARDS WHERE KELTHANE HAS BEEN USED FOR MANY YEARS (4-5 YEARS) EUROPEAN RED MITE HAS BECOME RESISTANT. ALSO IN A FEW ORCHARDS RED MITES ARE SHOWING SOME RESISTANCE TO PLICTRAN.				
	Tentiform leaf miner	Use one of: (1) [1]Lannate L *(2) Ambush 500 EC or Pounce 384 EC †*(3) Belmark 300 EC †*(4) Decis 2.5 EC †*(5) Ripcord 400 EC	 6.75 L 400 mL 520 mL 450 mL 500 mL 250 mL	Apply Lannate when new mines show on the lower leaf surface. Do not apply Lannate to Early McIntosh or Wealthy. Apply synthetic pyrethroids (materials 2, 3, 4, 5) when mines are visible on upper leaf surface and moths are abundant. Consult Horticultural Crop Advisor. Belmark should not be used within 60 days of harvest.
	Dogwood borer Apple bark borer	Ambush 500 EC plus superior oil	170 mL/1000 L 20 L/1000 L	Soak the trunk. Make 2 applications at 2-3 week intervals when adults are flying (late June to early Aug.) Consult Horticultural Crop Advisor.

Post Harvest Dips for Storage
Rots (See page 67.)

GUIDELINES FOR PROTECTING YOUNG NON-BEARING APPLE PLANTINGS

The following program is designed to offer **limited protection when needed for newly planted trees.** It is not intended to be used for protection of bearing orchards. Other protective measures included removal of neglected fruit trees in the area, careful selection of intercrops (where used) and a clean, weed free environment. Rates are for dilute spraying. **Alternate materials are available as shown in the calendar for bearing fruits.**

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER 1000 L	NOTES
EARLY SPRING	Phytophthora Collar Rot			See page 17
FIRST SPRAY	Scab Powdery Mildew Cedar Apple Rust	Dikar WP	2 kg	When green tissue shows. Repeat at 7- to 10-day intervals if wet weather occurs until late June.
PREBLOOM	Tentiform Leafminer	Synthetic Pyrethroid	—	See section for bearing apples, tentiform leafminer, page 19. Consult label for rates.
	Leaf-feeding insects	Imidan 50% WP	1.25 kg	Before blossoms open in bearing orchards. Apply when caterpillars are small. Include with one of fungicide sprays. Not necessary if synthetic pyrethroid was used for tentiform leafminer.
BLOOM	Fireblight	Agri-Mycin 17	600 g	Avoid overstimulating growth. See page 16.
SUMMER SPRAYS	Aphids Leafhoppers	Use one of: (1) Pirimor 50 WP (2) Cygon 480 E (3) [2]Systox 240 SC	500 g 1.25 L 625 mL	Spray if insects become abundant at any time.
	Tentiform leaf miner	[1]Vydate L	3 L	Vydate is very toxic to applicator. Timing is critical. If mines are visible on underleaf surface, consult Horticultural Crop Advisor or Pest Management Specialist prior to use.
	Mites	Plictran 50 W	375 g	Check foliage frequently for mite injury. Spray if more than 5 mites/leaf are observed or at first sign of leaf bronzing.
	Buffalo treehopper			Follow clean cultivation or remove legumes from cover crop.
	Phytophthora collar rot			See page 17.

Root Lesion Nematode. See Page 71 for Postplanting Treatment for nematodes on **NON-BEARING** apples.

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[1] *Minimum period before reentry is 24 hours.*

[2] *Minimum period before reentry is 48 hours*

[3] *Minimum period before reentry is 7 days.*

* *Repeated applications of synthetic pyrethroids are discouraged. See "Pesticide Resistance", page 7.*

† *See "Temporary Registration of Pesticides" inside front cover.*

APRICOTS

Read the label and follow all safety precautions.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER 1000 L	AMOUNT PER HECTARE	NOTES
DORMANT In late March or early April before buds swell	Red mite	Superior oil (see note)	20.0 L	60.0 L	Rate per 1000 L is based on 11.4 to 13.6 L of spray per mature tree.
PREBLOOM When blossom buds show pink	Brown rot Blossom blight	Use one of:			Apricots are extremely susceptible to brown rot at blossom time and just before picking.
		(1) captan 50% WP	2.0 kg	6.0 kg	
		or captan 80% WP	1.25 kg	3.75 kg	
		(2) sulfur 90-95% WP	6.0 kg	18.0 kg	
SHUCK-SPLIT When about 50% of shucks have split	Brown rot Plum curculio	Use one of the fungicides listed under **PREBLOOM** Add one of:			Apricots are extremely susceptible to brown rot. See notes on bee toxicity, page 9.
		(1) [2]Guthion 50% WP	625 g	2.0 kg	
		(2) methoxychlor 50% WP	4.5 kg	13.25 kg	
		(3) [3]parathion 15% WP	1.5 kg	4.5 kg	
		(4) Sevin 50% WP	2.0 kg	6.0 kg	
		or Sevin 85% WP	1.25 kg	4.25 kg	
SHUCK-FALL 10 to 12 days after last spray	Brown rot Plum curculio	Use same materials as for **SHUCK-SPLIT**			For peach tree borer refer to treatment as for peaches.
FIRST COVER 10 to 12 days after **SHUCK-FALL**	Plum curculio	Use one of the materials given for curculio in the **SHUCK-SPLIT.**			

The addition of Benlate 50% WP at 850 g to captan 50% WP at 4.25 kg/ha will improve brown rot control only where the fungus is not resistant to Benlate.

PRE-PICK	Brown rot	Use one of the fungicides listed under **PREBLOOM**			Apricots are extremely susceptible to brown rot just before picking.

[2] *Minimum period for reentry is 48 hours.*
[3] *Minimum reentry period is 7 days*

Notes:

RED MITE: Where this mite has been a problem add Superior oil 20 L to each 1000 L in the **DORMANT SPRAY**; and in the **PREBLOOM** or at **SHUCK-SPLIT**, spray with one of Kelthane AP-35 1.1 kg/1000 L or Kelthane 187.5 EC 2.5 L/1000 L; or Omite 30 WP 2.25 kg/1000 L.

POLLINATION: Most varieties are self-fruitful and may be planted in solid blocks. Since this crop blooms early when the weather is often unreliable, it is advisable to provide honeybees to assist in pollen transfer.

VERTICILLIUM WILT: Do not plant following tomatoes, strawberries, potatoes, eggplants or peppers. Also do not interplant with these crops.

CHERRIES (SWEET AND SOUR)

Read the label and follow all safety precautions. For dilute spraying, refer to page 9 "GUIDE FOR SPRAYING TREE FRUITS"

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Sweet	Sour	NOTES
DORMANT In spring when buds are dormant	Black cherry aphid (usually on Sweet Cherry only)	Elgetol (DNOC liquid)	17.0 L		If dormant spray could not be applied before buds started moving, use one of the alternate materials when buds are partially open, but before blossoms open.
OR AT BUD BREAK		Use one of:			
		(1) diazinon 50% WP	4.5 kg		A temperature of at least 21°C, thorough coverage and a calm day are needed for effective aphid control.
		(2) Thiodan 50% WP	4.5 kg		
		(3) Zolone 30% WP	4.5 kg		
PREBLOOM	Red mite (usually on Sour Cherry only)	Superior oil		65.0 L	Only needed in Sour Cherry orchards with a heavy mite population. Spray as buds are breaking. Apply oil at 3000 L/ha (dilute rate).
		or			
		Morestan 25% WP		2.25 kg	
	DO NOT APPLY INSECTICIDES WHEN CHERRY TREES ARE IN BLOOM See note on pollination, page 8.				
BLOOM	Brown rot (stem rot and blossom blight stages)	Use one of:			
		(1) captan 50% WP	9.0 kg	6.75 kg	Spray just before blossom buds open. If wet weather prevails, this spray should be repeated.
		or captan 80% WP	5.5 kg	4.25 kg	
		(2) Phygon-XL 50% WP	1.75 kg	1.75 kg	Do not use Phygon, Dichlone or captan following oil.
		or Dichlone 50% W	1.75 kg	1.75 kg	
		(3) Phaltan 50% WP	—	6.75 kg	Do not use Phaltan on Sweet Cherry.
		(4) Funginex 190 EC	2.5 L	2.5 L	Make two to three applications of Funginex from early to full bloom stage. See note "Funginex", page 8.
		(5) Rovral 50% WP	1.75 kg	1.5 kg	Do not use Rovral in consecutive sprays. Alternate with other fungicides.
		(6) sulfur 90-95% WP	27.0 kg	20.25 kg	
PETAL FALL	Leaf spot (Sour Cherry only)	Use one of:			
		(1) Cyprex 65% WP		2.25 kg	
		or Equal 65% WP		2.25 kg	
		(2) captan 50% WP		6.75 kg	Spray only if rain is forecast between **BLOOM** and **SHUCK** sprays.
		or captan 80% WP		4.25 kg	
		(3) Phaltan 50% WP		6.75 kg	Do not use Phaltan or Cyprex on Sweet Cherry.
		(4) Benlate 50% WP		850 g	
		plus captan 50% WP		3.25 kg	
		(5) ferbam 76% WP		6.75 kg	

CHERRIES (SWEET AND SOUR) (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Sweet	AMOUNT PER HECTARE Sour	NOTES
SHUCK	Plum curculio	Use one of:			Spray when most of the shucks are off.
		(1) [2]Guthion 50% WP	2.75 kg	2.00 kg	
		or [2]APM 50 W	2.75 kg	2.00 kg	
		(2) Zolone 30% WP	4.5 kg	3.25 kg	Zolone also helps control aphids.
		(3) Imidan 50% WP	—	4.25 kg	Do not use Imidan on Sweet Cherry.
	Brown rot	Add one of:			
		(1) captan 50% WP	9.0 kg	6.75 kg	
		or captan 80% WP	5.5 kg	4.25 kg	
		(2) Phygon 50% WP	1.75 kg	—	Phygon or Dichlone are not effective for Leaf Spot.
		or Dichlone 50% WP	1.75 kg		Do not use Phygon or Dichlone on Sour Cherry.
		(3) Phaltan 50% WP	—	6.75 kg	Do not use Phaltan on Sweet Cherry.
		(4) Rovral 50% WP	1.75 kg	1.5 kg	Do not use Rovral in consecutive sprays.
		(5) sulfur 90-95% WP	27.0 kg	—	Alternate with other fungicides.
	Leaf Spot	Use one of the fungicides recommended at **PETAL FALL**, with the exception of ferbam.			
	Red Mite	Kelthane AP-35		4.5 kg	Thorough coverage is necessary for good mite control. Only needed in heavily infested Sour Cherry orchards.
		or Kelthane 187.5 EC		8.5 L	
FIRST COVER 12 days after SHUCK	Plum curculio	Use one of the insecticides listed under **SHUCK.**			Zolone helps control aphids. Do not use Imidan on Sweet Cherry.
	Brown rot	Use one of the fungicides listed under **SHUCK.**			
	Leaf spot	Use one of the fungicides listed under **PETAL FALL**, with the exception of ferbam.			
SECOND COVER 12 days after **FIRST COVER**	Cherry fruit fly Plum curculio	Use one of:			
		(1) [2]Guthion 50% WP	2.75 kg	2.0 kg	On early varieties check interval from last spray to harvest date. See page 13. Spray when early varieties are beginning to color.
		or [2]APM 50 W	2.75 kg	2.0 kg	
		(2) diazinon 50% WP	4.5 kg	3.25 kg	
		(3) Zolone 30% WP	4.5 kg	3.25 kg	
		(4) methoxychlor 50% WP	13.5 kg	—	Diazinon and methoxychlor do not adequately control curculio.
		(5) Imidan 50% WP	—	4.25 kg	
	Brown rot	Add one of:			
		(1) captan 50% WP	9.0 kg	6.75 kg	
		or captan 80% WP	5.5 kg	4.25 kg	
		(2) Phaltan 50% WP	—	6.75 kg	Do not use Phaltan on Sweet Cherry.
		(3) Rovral 50% WP	1.75 kg	1.5 kg	Do not use Rovral in consecutive sprays.
		(4) sulfur 90-95% WP	27.0 kg	—	Alternate with other fungicides.
	Leaf spot	Use one of the fungicides as recommended at **PETAL FALL**, with the exception of ferbam.			

	Powdery mildew	Use one of:			
		(1) Benlate 50% WP		1.1 kg	Sulfur at this rate will suppress powdery mildew. Higher rates may cause injury. Phaltan used to control brown rot will also help control powdery mildew.
		(2) Sulfur 90-95% WP		10 kg	
THIRD COVER	Cherry fruit fly	Use one of:			
		(1) Sevin 50% WP	9.0 kg	6.75 kg	Spray Sour Cherry about the time Montmorency is turning pink.
		or Sevin 85% WP	5.5 kg	4.25 kg	
		(2) Imidan 50% WP	—	4.25 kg	Spray Sweet Cherry 10 days after Second Cover.
		(3) Zolone 30% WP	4.5 kg	3.25 kg	
		(4) diazinon 50% WP	4.5 kg	3.25 kg	Check harvest interval before spraying early maturing Sweet Cherry. See page 13.
		(5) methoxychlor 50% WP	13.5 kg	10 kg	
	Leaf spot Brown rot	Add one of the fungicides listed under **SECOND COVER.**			
The addition of Benlate 50% WP at 850 g to Captan 50% WP at 4.25 kg/ha will improve brown rot control only where the fungus is not resistant to Benlate.					
PRE-PICK (Sweet Cherry)	Brown rot	Use one of the fungicides listed under **SECOND COVER** for Sweet Cherry.			Spray each variety just before picking. Do not use Phaltan on Sweet Cherry.
POSTHARVEST ON FRUIT (Sweet Cherry)	Rhizopus rot (black whiskers)	Botran 75% WP	875 g per 500 L water		Dip harvested cherries in suspension of Botran and keep the mixture well agitated during use. Read directions on label.
POSTHARVEST	Leaf spot	Use one of:	**SWEET**	**SOUR**	Necessary where leaf spot is a problem.
		(1) Cyprex 65% WP	2.25 kg	2.25 kg	
		or Equal 65% WP	—	2.25 kg	
		(2) captan 50% WP	9.0 kg	6.75 kg	
		or captan 80% WP	5.5 kg	4.25 kg	
		(3) ferbam 76% WP	9.0 kg	6.75 kg	
		(4) Phaltan 50% WP	—	6.75 kg	Do not use Phaltan on Sweet Cherry.
		(5) Benlate 50% WP	1.1 kg	850 g	
		plus captan 50% WP	4.5 kg	3.25 kg	
	Powdery mildew	Benlate 50% WP		1.1 kg	
	Red mite	Use one of:			
		(1) Morestan 25% WP	2.25 kg	1.75 kg	If mites can easily be found on the leaves at this time, add a miticide with your fungicide application. Do **NOT** mix Morestan with any other product.
		(2) Omite 30% WP	6.75 kg	5.0 kg	
		(3) Kelthane AP-35	5.5 kg	4.5 kg	
		or Kelthane 187.5 EC	10 L	8.5 L	

[2] *Minimum period before reentry is 48 hours.*

CHERRIES (SWEET AND SOUR) (Continued)

Notes:

PEAR SLUG: If it appears on leaves of **non-bearing trees** in injurious numbers, spray Sevin 50% WP 1.0 kg per 500 L.

NEMATODES: See page 70 for methods of controlling nematodes when replanting old tree sites or whole orchards.

PEACH TREE BORER: Where a problem, spray as directed for **PEACH** (Page 41).

APHIDS: In sour cherry orchards where black cherry aphids are regularly a problem, apply the dormant spray recommended for Sweet Cherries. If aphids threaten to become troublesome during the season, spray with one of:

(1) diazinon 50% WP
3.25 kg/ha
(2) Thiodan 50% WP
3.25 kg/ha
(3) Zolone 30% WP
3.25 kg/ha

They may be added to any of the sprays after bloom. Thorough coverage and a calm warm day are necessary for good aphid control.

BACTERIAL CANKER: This disease causes wilted blossoms, spotting and collapse of leaves on spurs and gumming of twigs. If this disease is suspected, consult Horticultural Crop Advisors for a spray program through September and October.

CHERRY YELLOWS VIRUS: Where a problem, Gibberellic acid (ACTIVOL GA) has been shown to increase fruit spur development. Use at the rate of 10 ppm (10 ACTIVOL GA tablets per 1000 L of water). Use 9 L of spray per tree. Higher rates may be required for old or less vigorous trees. AGRAL 90 at the rate of 113 g per 450 L of water is suggested as a spreader sticker. Apply the spray during the period 7 to 21 days after petal fall. Gibberellic acid must be applied every year to improve bud development and later shoot growth. Follow manufacturer's directions.

POLLINATION: Sour cherry is self-fruitful and may be planted in solid blocks of one variety. However, they do require insects for pollen transfer. Honeybees readily work this crop.

Sweet Cherry is self-unfruitful and requires intervarietal plantings. Insects are essential for pollen transfer. Honeybees are excellent pollinators. Since the blossoms remain receptive for only a short time, bees should be moved into the orchard as soon as blossoming begins.

ALAR is a management tool for cherry production which can increase harvesting efficiency and marketing potential through its influence on the ripening process. The benefits of Alar include:

1. Advanced crop maturity of 5 - 7 days for sour cherries and up to 5 days for sweet cherries in the year of application.
2. Earlier and more uniform fruit colour development.
3. Increased amounts of colour development.
4. Easier separation of fruit from fruit pedicels (stem) at full maturity.

Alar is applied to cherry trees (both sweet and sour) 10 - 16 days after petal fall.

The rate of application is influenced by both the degree of vigour exhibited by the trees in question, and the degree of effect desired. Higher rates will emphasize the effect, and hasten the results.

RATE OF ALAR APPLICATION

Tree Condition	Sweet Cherries kg/ha	Sour Cherries kg/ha
low vigor	none	none
moderate to good vigor	5.00 - 6.75	6.75
very high vigor	6.75 - 9.00	10.00

Growers who are interested in trying it should keep the following points in mind:

1. Alar should only be applied once per season.
2. Under no condition should Alar be applied to trees that are under any form of stress, such as drought, low fertility, disease (i.e. Cherry yellows), mite injury, trees which produce less than desirable annual growth, or trees which normally produce large crops of small fruit.
3. Application should be delayed if rain is expected within 12 hours of spraying.
4. Alar works best when applied as a dilute spray (3300 L/ha) to the point of run-off. It can be successfully applied as a concentrate spray only when care is taken to ensure complete, and uniform coverage.

ETHREL: Ethrel is registered for commercial use as a chemical ripening and loosening aid. When applied according to manufacturer's directions the material tends to promote uniform maturity and loosens the fruit for easier mechanical harvest.

Follow the manufacturer's **precautions and directions** for best results.

Growers are particularly cautioned against the use of Ethrel on trees that have experienced severe stress such as drought, disease or winter injury. Ethrel applied to such trees frequently causes severe gummosis.

CURRANTS AND GOOSEBERRIES

For dilute spraying use 1800 L per hectare.
Amount per 450 L is one quarter rate per hectare.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER 450 LITRES	NOTES
Before buds break	Scale insects	Superior oil	9.0 L	
As buds are bursting	Currant insects	Malathion 25% WP	900 g	Spray when temperature is above 15°C.
Just before blossoms open	Leafspot	Use one of: (1) ferbam 76% WP (2) Phaltan 50% WP	 1.0 kg 1.2 kg	 Currants only. Currants and Gooseberries.
	Powdery mildew	Sulfur 90-95% WP	6.75 kg	Gooseberries only.
	Currant sawfly	(1) rotenone 5% WP (2) diazinon 50% WP	2 kg 500 g	Repeat as necessary. Diazinon is highly toxic to honeybees. See page 9.
Postbloom as soon as bloom is complete	Leafspot	Add one of fungicides listed above.		
	Powdery mildew	Same as for mildew above.		Repeat weekly if weather is wet.
	Currant Fruit Fly (maggot)	Use one of: (1) Methoxychlor 50% WP (2) Malathion 25% WP	 1.2 kg 900 g	Where this pest has been a problem, a second application is required in 10 days. Methoxychlor is not registered for mites, leafhoppers or aphids.
10 days after Postbloom spray	Leafspot	Same as for Leafspots above.		Do not use ferbam within 14 days of harvest or Phaltan within 7 days. Spray Red and White Currants immediately after fruit is picked.
	Currant Fruit Fly (maggot)	Same as for Fruit Fly above.		Do not use methoxychlor within 14 days of harvest or malathion within three days.
Postharvest	Leafspots	Same as for Leafspots above.		
	Leafhoppers, Mites, Aphids	Malathion 25% WP	900 g	

POLLINATION:
Currants and gooseberries are self-fertile, but insects assist in pollen transfer. Honeybees have been shown to increase crop yield. See page 9 for ways to reduce bee poisoning.

GRAPES

See Chart "Relative Disease Susceptibility" at the end of the Grape Calendar.

Read the label and follow all safety precautions. For dilute spraying refer to page 9 "GUIDE FOR SPRAYING TREE FRUITS"

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
PHOMOPSIS SPRAYS	**See note (a) page 35 for effectiveness of fungicides for control of grape diseases.**			
	Phomopsis cane and leaf spot	Use one of:		Spray varieties where phomopsis is a problem, when new shoots are 1.25 to 5 cm long, and again when 10 to 15 cm long. Apply at least 1700 L of spray per hectare.
		(1) captan 50% WP	3.25 kg	
		or captan 80%	2.0 kg	
		(2) Phaltan 50% WP	3.25 kg	
PREBLOOM	Berry moth	Use one of:		Spray shortly before bloom where berry moth has been a problem. Apply at least 1700 L/ha (dilute rate). For mealybug control use either Guthion 50% WP 1.1 kg or diazinon 50% WP 3.3 kg/ha. **WARNING:** Under slow-drying conditions or at temperatures above 24°C, any spray material or combinations are likely to cause some degree of injury, especially to the variety Foch.
		(1) [2]Guthion 50% WP	1.1 kg	
		or [2]Guthion 240 SC	2.0 L	
		or [2]APM 50 W	1.1 kg	
		(2) Sevin 50% WP	3.25 kg	
		or Sevin 85% WP	2.0 kg	
		(3) Imidan 50% WP	2.0 kg	
	Mealybug (see notes)	(4) Zolone 30% WP	2.5 kg	
		(5) diazinon 50% WP	1.75 kg	
	Downy mildew (see note (a) at end of Grape Calendar.)	Add one of:		Spray Buffalo, Fredonia, President, Van Buren, French Hybrid and vinifera varieties. If bloom is delayed or if wet weather is expected, repeat the application. Check combinations for compatibility. See Table 4.
		(1) Phaltan 50% WP	3.25 kg	
		(2) captan 50% WP	3.25 kg	
		or captan 80% WP	2.0 kg	
		(3) Polyram 80% WP	3.25 kg	
		(4) Dikar WP	3.25 kg	
		(5) Dithane M45 80% WP	3.25 kg	
		(6) Manzate 200	3.25 kg	
	Black rot	Use one of:		Susceptible varieties include Catawba, Concord, Agawam, Niagara, Pinot Chardonnay, Ventura, Dutchess. Refer to disease susceptibility chart for susceptibility of cultivars.
		(1) ferbam 76% WP	3.25 kg	
		(2) Dikar WP	3.25 kg	
		(3) Benlate 50% WP	850 g	
DO NOT APPLY INSECTICIDES WHEN GRAPES ARE IN BLOOM See note on pollination page 8.				
POST-BLOOM	Berry moth Leafhoppers	Use one of:		IMMEDIATELY BLOOM IS OVER, for effective control of berry moth, apply at least 2200 L/ha (dilute rate). For mealybug control, high-volume sprays are necessary; use either Guthion 50% WP 1.5 kg or diazinon 50% WP 4.5 kg/ha.
		(1)[2]Guthion 50% WP	1.5 kg	
		or [2]Guthion 240 SC	2.75 L	
		or [2]APM 50 WP	1.5 kg	
		(2) Sevin 50% WP	4.5 kg	
	Mealybug (see notes)	or Sevin 85% WP	2.75 kg	
		(3) Imidan 50% WP	2.75 kg	
		(4) Zolone 30% WP	3.25 kg	
		(5) diazinon 50% WP	2.25 kg	

	Grape Phylloxera (leaf form)	Add:		Only French hybrid and vinifera varieties are susceptible to this pest. Thiodan may cause injury to Concord, Cascade, Baco, Seibel 8357 and Seibel 7053 (Chancellor).
		Thiodan 50% WP	2.25 kg	
	Downy mildew Black rot	Add one of:		Spray all varieties for mildew at this time. Repeat spray for black rot where it is a problem.
		(1) Phaltan 50% WP	4.25 kg	
		(2) captan 50% WP	4.25 kg	
		or captan 80% WP	2.75 kg	
		(3) Polyram 80% WP	4.25 kg	
		(4) Dikar WP	4.25 kg	
		(5) Dithane M45 80% WP	4.25 kg	
		(6) Manzate 200	4.25 kg	
	Powdery mildew	Use one of:		A program for powdery mildew is most effective when started at this time. DO NOT use sulfur on Concord, Foch, Van Buren or De Chaunac. SEE warning under **PREBLOOM.**
		(1) sulfur 90-95% WP	9.0 kg	
		(2) Karathane WD 18.25% WP	1.1 kg	
		(3) Dikar WP	4.5 kg	
		(4) Benlate 50% WP	1.1 kg	
	Botrytis bunch rot			**See note C at the end of GRAPE calendar.**
FIRST COVER 12 days after **POST BLOOM**	Berry moth	Use one of:		Where berry moth is a regular problem, apply one of these materials at a rate of 2800 L (dilute) per hectare. Thorough spraying reduces chance of a late second brood.
		(1) [2]Guthion 50% WP	1.75 kg	
		or [2]Guthion 240 SC	3.1 L	
		or [2]APM 50 W	1.75 kg	
		(2) Sevin 50% WP	5.5 kg	
		or Sevin 85% WP	3.25 kg	
		(3) Imidan 50% WP	3.25 kg	
		(4) Zolone 30% WP	4.25 kg	
		(5) diazinon 50% WP	2.75 kg	
	Phylloxera (leaf form)			Repeat as in **POSTBLOOM SPRAY.**
	Powdery Mildew	(1) Dikar WP	5.5 kg	
		(2) Karathane WD 18.25% WP	1.5 kg	
		(3) sulfur 90-95% WP	11.0 kg	
		(4) Benlate 50% WP	1.5 kg	
		(5) Phaltan 50% WP	5.5 kg	
	Downy mildew Black rot	(1) Dikar WP	5.5 kg	Repeat spray for black rot where it is a problem.
		(2) Phaltan 50% WP	5.5 kg	
		(3) captan 50% WP	5.5 kg	
		or captan 80% WP	3.25 kg	
		(4) Polyram 80% WP	5.5 kg	
		(5) Dithane M-45 80% WP	5.5 kg	
		(6) Manzate 200	5.5 kg	

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[2] *Minimum period before reentry is 48 hours.*

GRAPES (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
SECOND COVER 10 days after **FIRST COVER**	Powdery mildew	Use one of: (1) sulfur 90-95% WP (21 days) (2) Karathane WD 18.25% WP (30 days) (3) Dikar WP (30 days) (4) Benlate 50% WP (7 days)	11.0 kg 1.5 kg 5.5 kg 1.5 kg	DO NOT use sulfur on Concord, Foch, De Chaunac or Van Buren varieties. For effective control of powdery mildew apply at least 2800 L/ha (dilute rate). Do not apply fungicides any closer to harvest than the interval states.
	Black rot	Use one of: (1) ferbam 76% WP (2) Dikar WP (3) Benlate 50% WP	4.5 kg 4.5 kg 1.25 kg	Repeat spray for black rot where it is a problem. For effective control, apply at least 2800 L/ha (dilute rate).
	Botrytis bunch rot	Rovral 50% WP (7 days)	1.5 kg	To minimize the development of resistance it is strongly suggested that only two applications of Rovral be made per season, these being in late July and mid-August as bunches are closing. See note C at the end of the Grape Calendar.
FURTHER COVER SPRAYS	Powdery mildew (see note d.)	Use one of the materials listed under **SECOND COVER** and check for interval to harvest.		Varieties such as Concord, Niagara, Elvira and Fredonia are not as susceptible to this disease and extra sprays are usually not needed. Susceptible varieties such as Agawam, Delaware, French hybrid, New York Muscat, Seneca and vinifera cultivars often require extra sprays at 10-DAY intervals.
	Berry moth about August 20	Use one of the materials listed under, **FIRST COVER** and check for interval to harvest.		A spray may be needed on late varieties to control the brood which emerges in late August.
	Botrytis bunch rot	Rovral 50% WP (7 days)	1.5 kg	See note C at the end of the Grape Calendar.

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[2] *Minimum period before reentry is 48 hours.*

Notes:

a. EFFECTIVENESS OF FUNGICIDES FOR CONTROL OF GRAPE DISEASES:

Fungicide	Phomopsis cane and leaf spot	Black rot	Downy mildew	Powdery mildew	Botrytis bunch rot
Phaltan (1 day)	+ + +	+ +	+ + +	+ +	+
captan (7 days)	+ + +	+ +	+ + +	0	+
Dikar (30 days)	+	+ + +	+ + +	+ + +	0
Dithane M-45 (30 days)	+	+ + +	+ + +	+ + +	0
Manzate 200 (30 days)	+	+ + +	+ + +	+ + +	0
ferbam (7 days)	+	+ + +	+ + +	+ + +	0
Sulfur (21 days wine, 1 day table)	0	0	0	0	0
Benlate (7 days)	+	+ +	0	+ + +	0
Karathane (30 days)	0	0	0	+ + +	0
Rovral (7 days)	0	0	0	+	+ + +
Copper-lime (30 days, wine grapes)	+	+ +	+ +	+ +	0
Polyram (45 days)	?	+ + +	+ + +	0	0

RELATIVE DISEASE SUSCEPTIBILITIES

This chart provides a relative rating of cultivar susceptibility under average conditions. Under adverse weather conditions, i.e. extended cool weather, any given cultivar may be more seriously affected.

Blank — relative susceptibility is unknown
+ = slight susceptibility
+ + = moderately susceptible
+ + + = highly susceptible
* This disease is more serious adjacent to bush areas or where there is poor air drainage

1 = sulfur sensitive
2 = Dikar + Zolone combination may be phytotoxic
3 = Dikar sensitive
4 = Karathane sensitive
5 = Thiodan sensitive

CULTIVAR	RATING OF SUSCEPTIBILITY TO DISEASES						CHEMICAL SENSITIVITY (PHYTOTOXICITY EXPERIENCED)
	Eutypa (dead arm)	Phomopsis (cane and leaf spot)	Black Rot*	Downy Mildew	Powdery Mildew	Botrytis Bunch Rot	
Lubrusca							
Agawam	+	+ +	+ + +	+ + +	+ +		
Canada Muscat			+	+ +	+ + +		
Canadice					+		
Catawba	+	+	+ + +	+ + +	+ +		
Concord	+	+ +	+ +	+ +	+ +		1,4,5
Delaware	+ +		+ +	+ + +	+ +	+	4
Dutchess	+ +	+ +	+ +	+ +	+ +	+	
Elvira	+ + +	+ + +	+ +	+	+ +	+ +	
Festivee					+ +	+ +	
Fredonia	+	+ +	+ +	+ + +	+ +	+	

GRAPES (Continued)

Van Buren	+			+ + +	+ +		1
Veeblanc (V53263)			+ +		+ +	+ +	
Himrod					+ +		
N.Y. Muscat	+		+		+ + +		
Niagara	+ +	+ +	+ + +	+ + +	+ +	+	
Veeport	+	+	+		+ + +		
Ventura	+ +	+ +	+ +		+ +	+	
Vincent		+			+ + +		
Vivant (63331)	+	+	+ +	+ +	+ +	+	
V 50201	+ +	+		+ + +	+ +		
Vinifera							
Chardonnay			+ +	+ +	+ + +	+ + +	3,4
Riesling		+	+	+ +	+ + +	+ + +	
Gamay			+	+ +	+ + +	+ +	
French Hybrids:							
Aurore		+ +	+	+	+ + +	+ +	4
Baco Noir			+		+ +	+	4,5
Chambourcin (J.S. 26205)					+ +	+	
Chancellor (S7053)			+	+ + +	+ + +	+	1,4,5
Chelois (S10878)	+ + +		+ +	+	+ + +	+	3,4
Couderc Muscat (C-29935)			+ +		+ + +	+	
De Chaunac (S9549)	+	+ + +	+	+	+ +	+	1,4
Foch	+ +	+ +	+		+ +	+	1,2,3,4
Le Commandant (BS2862)	+		+ +		+ +	+	2
Rosette (S1000)			+ +	+	+ +	+	4
Seyval Blanc (SV5276)		+ +	+ +	+ +	+ + +	+ +	
Verdelet (S9110)	+				+ +		
Vidal 256		+	+		+ +	+	4
Villard Noir (SV18-315)					+ +		3

b. **FIXED COPPER:** Fixed copper 50-53% WP 750g and hydrated lime 3000 g will help control powdery mildew, when used for control of downy mildew on the less susceptible varieties, but is not sufficiently effective on varieties which are very susceptible to powdery mildew. (Harvest interval on wine grapes is 30 days.) The fixed copper and lime mixture will not control powdery mildew but is involved in hardening of the plant tissue, thereby making it less suceptible. Copper cannot be used on French hybrid or vinifera varieties, and is NOT compatible with any of the presently recommended insecticides. It may be used, however when no insecticides are being applied.

c. **BUNCH ROT:** Many of the vinifera and vinifera hybrid cultivars with tight bunches are susceptible to Botrytis bunch rot e.g. Gamay, Riesling, Chardonnay, Chancellor, Aurore and Seyval Blanc. Rovral is the only fungicide currently registered for control of bunch rot, but already Rovral-resistant *Botrytis cinerea* has been found in several Ontario vineyards where Rovral has been used. Benlate cannot be recommended because of the widespread distribution of Benlate-resistant botrytis in vineyards. The only alternatives are Captan and Phaltan which have moderate to good activity, but their use against bunch rot is not currently registered.

To minimize the development of resistance to Rovral it is strongly proposed that only two applications of Rovral be made per season, and these should be made in late July and mid-August as bunches are closing. On late-harvested cultivars, a third application in early September may protect ripening berries from direct infection during wet weather. To obtain adequate spray coverage during mid and late summer use at least 900 L of spray per hectare. The protection of clusters from Bloom to mid-July may be obtained by the use of Captan or Phaltan at the rates recommended for the control of downy mildew given under First Cover.

d. **POSTHARVEST POWDERY MILDEW SPRAY:** The powdery mildew organism will attack leaves, fruit and canes of grape.

It has been observed that winterkill is more serious on infected canes. Bright sunny days and cool nights with heavy dews are ideal conditions for the continued spread of this disease. Susceptible cultivars include Aurore, Agawam, Delaware and many French hybrids and where powdery mildew infection is present on the leaves, growers are advised to apply one or two postharvest sprays to protect the wood for next year. Use sulfur, Dikar or Benlate according to manufacturer's directions.

POLLINATION: All commercial varieties grown in Ontario are self-fruitful and it is not considered necessary to provide honeybees for pollination.

Chemical Control of Fruit Set: Some grape varieties (usually labrusca types) frequently set too light a crop of fruit whereas others consistently set too heavily (often French hybrids). Chemicals are available to alter these effects. Alar will induce greater fruit set and Ethrel will cause flowers or young fruits to drop off. Ethrel is still in the experimental category for thinning, while Alar has been registered to alter fruit set.

Alar 85

1. The greatest increase in fruit set has occurred with Concord, Agawam and Fredonia. Little or no response can be expected on French hybrids.
2. Other varieties respond in varying degrees depending upon season and growing conditions.
3. Rates

Pruning Weight per vine	kg of Alar-85 per 1000 L	kg/ha
0.7 kg or less	DO NOT USE	—
0.7-1.4 kg	0.75-1.25	1.1-2.25
1.4-2.3 kg	1.25-2.0	2.25-3.25
2.3 kg or more	2.0-2.75	3.25-4.5

Experience with Alar is limited in some varieties. Growers who are interested in trying Alar should do so on a trial basis, keeping the following points in mind:

1. Alar requires a 12-hour rain-free period for absorption.
2. Applied between trace bloom and 50% bloom, Alar is effective in altering fruit set. Delayed applications will affect vegetative growth but not fruit set.
3. Apply as a dilute spray pending further research on concentrate spraying.
4. Do not mix with pesticides.
5. Alar should only be applied once during the growing season.
6. Livestock should not be grazed on vineyard cover crops treated with Alar.
7. Always leave some unsprayed vines to assess the effectiveness of the Alar treatment.

PEACHES and NECTARINES

A Pest Management Program for Control of Insects Attacking Peach is Available (see page 8). Details May Be Obtained from your Horticultural Crop Advisor.

For dilute spraying refer to page 9, "GUIDE FOR SPRAYING TREE FRUITS"

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
DORMANT In March or early April before buds swell	Leaf-curl only (Spring leaf-curl spray is not needed where a spray was applied last fall.)	Use one of:		
		(1) ferbam 76% WP	6.75 kg	Delay may result in poor control of leaf curl.
		(2) DNOC liquid (Elgetol)	17 L	Oil may be added to the ferbam spray to control scale insects. Dilute ferbam in tank, then add oil. See note (A) at end of **PEACH** calendar.
	San Jose Scale	Add one of:		Apply oil routinely every third year. If scale is a serious, or continuing problem, apply oil for at least two consecutive years.
		(1) superior oil	65 L	
		(2) Ethion superior oil	65 L	
PREBLOOM Half-inch Green to First Pink	Red mite	Use one of:		
		(1) superior oil	65 L	Preferred time to use oil for red mite control.
		(2) Ethion superior oil	65 L	
		(3) superior oil concentrate	17 L	
PINK THROUGH BLOOM	Blossom blight stage of brown rot	Use one of:		
		(1) captan 50% WP	6.75 kg	Spray when first blossoms are opening (late pink). Repeat at four-to-five-day intervals if weather is wet.
		or captan 80% WP	4.25 kg	
		(2) Phygon-XL 50% WP	1.75 kg	
		or Dichlone 50% WP	1.75 kg	
		(3) Rovral 50% WP	1.5 kg	Do not use Rovral in consecutive sprays. Alternate with other fungicides. See section on fungicide resistance, page 7.
		(4) Funginex 190 EC	2.5 L	Make two to three applications from early to full bloom stage. See notes on Funginex, page 8.
		(5) sulfur 90-95% WP	20.25 kg	
PETAL FALL	Red mite	Use one of:		
		(1) Plictran 50 WP	1.25 kg	
		(2) Kelthane AP-35	4.5 kg	
		or Kelthane 187.5 EC	8.5 L	
	Mealy bug	Use one of:		
		(1) [3]parathion 15% WP	5 kg	Check for Mealybug when shucks start to split and if necessary apply spray at 50% shuck split and repeat in 10 to 12 days. See Shuck Spray.
		(2) diazinon 50% WP	3.25 kg	

SHUCK SPRAY	Oriental fruit moth	Use one of:		
		(1) Imidan 50% WP	4.25 kg	Where Mealybug is a problem, use parathion or add diazinon to one of the other materials. See Petal Fall Spray. Thorough spraying is essential to control Mealybug.
		(2) ^{2}Guthion 50% WP	2.0 kg	
		or ^{2}APM 50 W	2.0 kg	
		(3) ^{3}parathion 15% WP	5 kg	
		(4) Sevin 50% WP or	6.75 kg	
		Sevin 85% WP	4.25 kg	
		*(5) Ambush 500 EC	200 mL	Repeated applications of Ambush, Decis or Pounce are discouraged. See "Pesticide Resistance" page 7.
		†*(6) Decis 2.5 EC	400 mL	
		*(7) Pounce 384 EC	275 mL	
	Plum Curculio	Use one of:		
		(1) ^{2}Guthion 50% WP	2.0 kg	
		or ^{2}APM 50 W	2.0 kg	
		(2) ^{3}parathion 15% WP	5.0 kg	
		(3) Imidan 50% WP	4.25 kg	
		(4) Sevin 50% WP	6.75 kg	
		or Sevin 85% WP	4.25 kg	
		*(5) Ambush 500 EC	400 mL	
	Red mite	If a dormant oil was not applied add one of:		
		(1) Omite 30 WP	5.5 kg	
		(2) Plictran 50 WP	1.25 kg	
		(3) Kelthane AP-35	4.5 kg	
		or Kelthane 187.5 EC	8.5 L	
	Tarnished plant bug	(1) Cygon 480 E	1.75 L	This spray may be necessary in Essex-Kent counties where early season plant bug injury has been a problem. This spray is usually not necessary on the Niagara Peninsula. Some defoliation may occur from Cygon under some conditions. See note (D).
		*(2) Ambush 500 EC	400 mL	
	Lesser peach tree borer Peach tree borer			See note (B) at end of **PEACH** calendar.
SPECIAL SPRAY	Oblique-banded leafroller	Use one of:		
		(1) Imidan 50% WP	4.25 kg	Where this pest has been a problem in past years, consult Horticultural Crop Advisor for proper timing.
		(2) ^{2}Guthion 50% WP	2.0 kg	
		or ^{2}APM 50 W	2.0 kg	

* *Repeated applications are not recommended. See "Pesticide Resistance"* Page 7.

[2] *Minimum period of reentry is 48 hrs.*

[3] *Minimum period of reentry is 7 days.*

† *See "Temporary Registration of Pesticides" inside front cover.*

PEACHES and NECTARINES (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
	Tarnished plant bug	(1) Cygon 480 E (2) ^{2}APM 50 W or ^{2}Guthion 50% WP (3) Thiodan 50% WP *(4) Ambush 500 EC	1.75 L 2.0 kg 2.0 kg 4.5 kg 400 mL	Where this pest has been a problem in past years consult Horticultural Crop Advisor for proper timing. General timing is about mid-June. Where plant bug pressure is high, sprays may have to be repeated in 10-12 days.
FIRST COVER	Oriental fruit moth	Use same insecticide as in **SHUCK SPRAY**		See note (C) at end of **PEACH** calendar.
Spray all varieties about July 6. See spray service letters or call Agri-phone.	Brown rot	When spraying varieties maturing before Redhaven, add one of: (1) captan 50% WP or captan 80% WP (2) sulfur 90-95% WP (3) Rovral 50% WP	6.75 kg 4.25 kg 20.25 kg 1.5 kg	See note (C) at end of **PEACH** calendar See note in Pink through Bloom.
SPECIAL SPRAY	Red mite	If necessary, apply one of the miticides as in the **SHUCK SPRAY.** Examine each variety for mites three weeks before harvest. More than one mite per leaf (average) in mid-July can result in a mite infestation in August. Do not apply any of these miticides closer to harvest than in Table 5.		
SECOND COVER	Oriental fruit moth	Use one of: (1) Imidan 50% WP (2) Sevin 50% WP or Sevin 85% WP *(3) Ambush 500 EC †*(4) Decis 2.5 EC *(5) Pounce 384 EC	4.25 kg 6.75 kg 4.25 kg 200 mL 400 mL 275 mL	Spray all varieties, Redhaven season and later about August 4. See spray service letters or call agri-phone. See note (C) at end of **PEACH** calendar. Repeated applications of Ambush, Decis or Pounce are discouraged. See "Pesticide Resistance" page 7.
	Brown rot	Use the same as for **FIRST COVER**, above.		
	Red mite	The same as for **SPECIAL SPRAY**, above.		
THIRD COVER	Oriental fruit moth Brown rot	Use same material as for **SECOND COVER.**		Loring and later maturing varieties. Spray each variety 12 to 14 days before harvest. See note (C) at end of **PEACH** calendar.

	Red mite	Use the same as for **SPECIAL SPRAY**, above.		
The addition of Benlate 50% WP at 850g to captan 50% WP at 4.25 kg/ha will improve brown rot control only where the fungus is not resistant to Benlate.				
HARVEST Just before picking each variety	Brown rot	Use one of: (1) captan 50% WP or captan 80% WP (2) sulfur 90-95% WP (3) Rovral 50% WP	 6.75 kg 4.25 kg 20.25 kg 1.5 kg	 In wet weather repeat applications between pickings. See note in Pink through Bloom.
	Rhizopus rot	Botran 75% WP	3.25 kg	
POSTHARVEST TREATMENT	Rhizopus rot (black whiskers)	Botran 75% WP	875 g/500 L water	Dip harvested peaches in a suspension. Keep suspension agitated while dipping. Read the label.
FALL SPRAY Preferred time to spray for leaf-curl	Leaf-curl	Use one of: (1) Difolatan 480 F (2) ferbam 76% WP (3) DNOC Liquid (Elgetol)	 17 L 6.75 kg 17 L	 Difolatan 480 F may be used before leaf drop is complete. One application only in early to late November. Use at least 750 L of spray per hectare. Any time after leaves are off in fall or winter when temperature in shade is above freezing, and conditions favor rapid drying.
	X-Disease	Terramycin® injection		See note (E) at end of **PEACH** calendar.

Notes:

A. **Oil and Ferbam:** Ferbam should be added to water in a partially filled tank before oil is added. With agitator running, sift ferbam slowly into water or, preferably, slurry in with water in a pail and then add to tank. Add oil last, as remainder of water is being added. To keep mixture uniform, do not stop engine until contents of tank are sprayed out. If oil is noticed floating on top of water, remix by turning a spray gun into tank. Injury may result to last few trees at end of tank if emulsion breaks.

B. **Lesser Peach Tree Borer and Peach Tree Borer:** Make three applications, the **first** — 5 to 10 days after the **SHUCK** spray, the **second** — three weeks later, and the **third** — three weeks after the second. Apply the sprays with a gun and cover the trunk and scaffold limbs thoroughly. **In the first spray,** use Thiodan 50% WP 1.5 kg per 1000 L or Thiodan 4 EC 1.75 L per 1000 L or Endosulfan 400 EC 1.75 L per 1000 L. **In the second spray**, use Thiodan as above on all varieties **except** those in the Earlired, Cardinal, Dixired and Garnet Beauty season. On such varieties use malathion 25% WP 2.0 kg or Sevin 50% WP 2.0 kg per 1000 L. **In the third spray**, use Thiodan as above on all varieties **except** those in the Sunhaven, Redhaven, Golden Jubilee and Envoy season. On such varieties use malathion or Sevin as in the second spray.

Preplant Treatment: Some nurseries dip the roots and crown of peach trees in Thiodan, which gives complete control of peach tree borer in the first, and partial control in the second year after planting. If your trees were not treated at the nursery, dip the roots and crown in the following: either Thiodan 4EC 1.25 L or Thiodan 50% WP 1.25 kg or Endosulfan 400 EC 1.25 L diluted with 100 L of water. The Thiodan wettable powder preparation must be stirred constantly to prevent settling out.

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* *Repeated applications are not recommended. See "Pesticide Resistance" Page 7.*

‡ *Minimum period of reentry is 48 hrs.*

† *See "Temporary Registration of Pesticides" inside front cover.*

PEACHES and NECTARINES (continued)

Special Precautions: Use rubber gloves to avoid exposing skin to insecticide. Dispose of excess material with extreme care. Thiodan is extremely toxic to fish and wildlife.

C. **Oriental fruit moth and brown rot sprays:**

1. Spray both bearing and young non-bearing peach trees, omitting fungicide on the non-bearing trees.
2. First and Second Cover Sprays — the suggested dates are approximate only. Timing in each area will depend on the development of the fruit moth in that area. Watch spray service letters **and listen to Agriphone and radio reports** for recommended dates.
3. Varieties maturing before Loring require two cover sprays. Loring and later maturing varieties require three cover sprays.
4. If weather conditions are unusual additional sprays may be necessary. Watch spray service letters **and listen to Agriphone and radio reports** for recommended dates.

D. **Plant Bugs:** Plant bugs overwinter in waste areas and may be numerous in peach orchards about blossom time, causing early injury or "cat-facing." First generation adult plant bugs may also move into peach orchards from headlands or hay fields about the time alfalfa blooms, causing fruit gumming. To present "cat facing" apply one of the materials listed at the Shuck Spray. To prevent fruit scarring and gumming apply one of the materials listed for plant bugs in the Special Spray.

Note: Cygon has caused some defoliation under certain conditions, e.g. cold wet soil and/or slow drying conditions during and following application. Least injury has occurred when sprays were applied in the morning while temperatures are moderate and drying conditions fairly good.

E. **X Disease:** May be transmitted to peach by leafhoppers flying from infected choke-cherry or cultivated cherry trees which may show no sign of having the disease. Infected peach trees decline quickly and die within a few years if not treated chemically. When the disease is detected in a tree, normal growth and fruiting can be restored by an application of Terramycin^{R} after harvest and before leaf fall. Best results may be obtained from September treatments and up to two years suppression of symptoms is possible. Follow manufacturer's label directions for injection method. See also OMAF Factsheet, X-Disease of Peach, Agdex 212/634.

F. **Other Formulations Available:** Aqua Parathion 800E may be used in place of 15% parathion WP; Guthion spray concentrate may be used in place of 50% Guthion WP. Follow manufacturer's directions.

PEACH CANKER — THE FOLLOWING PRACTICES AID GREATLY IN THE PREVENTION OF PEACH CANKER:

When pruning, growers should avoid cutting into the collar area of the branch or limb where it meets scaffolding or the trunk of the tree. Evidence from the United States suggests that when the collar area is injured or cut in any way, the healing process is delayed or impaired since wound periderm tissues are located primarily in the collar region.

At Planting Time and First Year

1. Plant good nursery stock. Use thiodan dip for borer control. See note (b).
2. When pruning at planting time, remove all poor angles and weak side branches.
3. Treat all cuts immediately with a wound dressing.
4. Go over trees in mid-June and remove all dead wood and obviously poorly angled live branches.
5. Cut out cankers in June and treat with a wound dressing.
6. Apply sprays for fruit moth, peach tree and lesser borer.
7. Sow a cover crop (early July).
8. Protect from rabbits and mice.

Second Year and Following Years

1. Apply nitrogen fertilizers early (March, April) to bearing trees. Avoid late applications of manure.
2. Prune as late in the spring as possible. Prune two- and three-year-old trees after bloom.
3. Do not prune immediately preceding rains.
4. Remove all dead wood and poorly angled branches.
5. Treat pruning cuts in the main scaffold areas of the tree with a wound dressing.
6. Go over scaffolds in June and remove dead wood and poorly placed new growth.
7. In June cut out any cankers on scaffolds and treat with a wound dressing.
8. Apply sprays for fruit moth, peach tree borers, plant bugs and brown rot.
9. Sow a cover crop (early July).
10. Protect from rabbits and mice.

Use the following wound dressing:

Thiram — Latex Paint — as suggested for south-west injury (see page 69.) It has shown to be an effective wound dressing for peach trees at the Research Station in Harrow. (Use on a trial basis only.) Dissolve 400 g thiram 75% WP in 2 L of water. Add slowly to 4 L of good exterior white latex house paint and mix well.

NEMATODE CONTROL: See page 70.

ALAR

The benefits of Alar to peaches are:

1. More uniform ripening.
2. Advanced maturity by up to 7 days over untreated peaches, depending on the variety and the rate at which Alar is applied. (Higher the rate, greater this advancement.)
3. Earlier and more uniform development of both flesh and skin colour.

Alar may be applied to peaches any time between style abscission (3 weeks after petal fall) and pit hardening (6 - 7 weeks after petal fall).

For best results, early peach varieties should be sprayed closer to style abscission, and later varieties closer to the pit hardening stage.

The rate of application of Alar is influenced by both tree vigor and the degree of effect desired.

RATE OF ALAR APPLICATION

Tree Condition	Peaches kg/ha
low vigor	none
moderate to good vigor	5.00 - 6.75
very high vigor	6.75 - 9.00

Growers using this material should keep the following points in mind.

1. Apply Alar only once per season.
2. Do not apply Alar to low vigor peach trees as this may result in an undesirable effect on vegetative growth and fruit size.
3. Application should be delayed if rain is expected within 12 hours of spraying.
4. Do not apply Alar after pit hardening has been completed.
5. Alar works best when applied as a dilute spray (3300 L/ha). It can be successfully applied as a concentrate spray, only when care is taken to ensure complete and uniform coverage.

POLLINATION: All commercial varieties grown in Ontario are self-fruitful and may be planted in solid blocks. Bees readily work peach blossoms and frequently cause an over-set, which may necessitate thinning. For this reason, the placement of hives in peach orchards is not usually recommended.

PEARS

Read the label and follow all safety precautions. For dilute spraying refer to page 9, "GUIDE FOR SPRAYING TREE FRUITS"

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
GREEN TIP	Scab	Use one of:		
		(1) Cyprex 65% WP or Equal 65% WP (2) captan 50% WP or captan 80% WP	3.25 kg 3.25 kg 6.75 kg 4.25 kg	It is important to start scab control early and repeat the spray if weather remains wet.
		(3) Dikar W (4) Benlate 50% WP plus Manzate 200	6.75 kg 550 g 3.25 kg	See note (3) at end of pear calendar. Alternate Benlate-Manzate with full rates of captan, Dikar, Cyprex or Equal to avoid Benlate resistance.
	Red mite Pear psylla Scale insects	Use one of: (1) superior oil (2) ethion superior oil	 65 L 65 L	Best applied at or near green tip for mites. Good coverage necessary.
	Red mite only	Superior oil concentrate	17 L	
PREBLOOM As blossom buds show white at tips	Scab	Add one of the fungicides listed for Scab Control under GREEN TIP		Repeat spray if weather remains wet.
	Rust mite and red mite	Use one of:		
		(1) Morestan 25% WP	2.25 kg	Rust mite control must be started now. See note (2) at end of PEAR calendar. Alternate miticides. Morestan is also effective against pear psylla at 6.75 kg/ha rate. Morestan should not be used within 14 days of oil.
		(2) Carzol 92 SP	1.1 kg	Carzol is harsh on beneficial mite species and bees.
		(3) Plictran 50 W	1.25 kg	
		(4) Kelthane AP-35 or Kelthane 187.5 EC	4.5 kg 8.5 L	Some resistant mites may be present where Kelthane has been used for four or more years and an alternative miticide is advisable
		(5) ethion 25% WP	6.75 kg	
	Pear Psylla	Use one of:		To avoid resistance problems, synthetic pyrethroids are not recommended at this time. Refer to notes at **PETAL FALL.**
		(1) Morestan 25% WP	6.75 kg	Morestan must not be used within 14 days of oil.
		(2) ^{2}Guthion 50% WP or ^{2}APM 50 W	2.1 kg 2.1 kg	Guthion and APM will also control green fruitworm.
		(3) Thiodan 50% WP	5-6.75 kg	Check the label.

	Green fruitworm	Use one of: (1) [2]Guthion 50% WP or [2]APM 50 W (2) Zolone 30% WP (3) Imidan 50% WP	 2.1 kg 2.1 kg 3.25 kg 4.25 kg	
	Plant bugs	Thiodan 50% WP	3.25-4.5 kg	Check the label. Thiodan helps to control psylla.
	DO NOT APPLY INSECTICIDES WHEN PEAR TREES ARE IN BLOOM. See note on Pollination page 8.			
BLOOM	Fire blight	Agri-Mycin 17 100 ppm	600 g/1000 L	High volume spraying preferable. Use alone for best results. Also see page 16.
PETAL FALL	Psylla Plum curculio	Use one of: (1) [2]Guthion 50% WP or [2]APM 50 W (2) Thiodan 50% WP †*(3) Belmark 300 EC †*(4) Decis 2.5 EC †*(5) Ripcord 400 EC *(6) Ambush 500 EC or Pounce 384 EC (7) Imidan 50% WP (8) Zolone 30% WP	 2.1 kg 2.1 kg 5-6.75 kg 450 mL 700 mL 250 mL 400 mL 520 mL 4.25 kg 3.25 kg	Materials 2, 4 and 6 are not registered for curculio control. Check the label. To avoid problems with pesticide resistance the synthetic pyrethroids (materials 3, 4, 5 and 6) are not preferred at this time. Synthetic pyrethroids should only be applied once per year. Apply these materials only under emergency situations where psylla populations are extremely high at petal fall.
	Rust mite Red mite	Add one of the miticides listed in **PREBLOOM.**		Two early season sprays are necessary for good mite control. Rust mite must be controlled by this time to avoid russeted fruit at harvest. Alternate miticides.
	Leaf spots Pear scab	Add one of the fungicides listed for Scab under **GREEN TIP.**		If weather is wet extra sprays will be needed for scab control before **FIRST COVER.**
	Mealybug			See note (1) at end of **PEAR** calendar.
SPECIAL SPRAY	Oblique-banded leafroller	Use one of: (1) Imidan 50% WP (2) [2]Guthion 50% WP or [2]APM 50 W †*(3) Belmark 300 EC	 4.25 kg 2.1 kg 2.1 kg 450 mL	Where pest has been a problem, consult Horticultural Crop Advisor for proper timing. A second spray may be necessary in mid-August. Belmark should not be used within 60 days of harvest.
FIRST COVER About June 25	Psylla	Use one of: †*(1) Decis 2.5 EC †*(2) Belmark 300 EC †*(3) Ripcord 400 EC	 700 mL 450 mL 250 mL	Preferred time for psylla control with synthetic pyrethroids (materials 1-4). Use of synthetic pyrethroids is only recommended once per year and only when there are high populations of psylla.

(Continued on page 46)

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[2] *Minimum period before reentry is 48 hours.*

* *Repeated applications of synthetic pyrethroids are discouraged. See "Pesticide Resistance", page 8.*

† *See "Temporary Registration of Pesticides" inside front cover.*

PEARS (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
FIRST COVER *(Continued)*		*(4) Ambush 500 EC	400 mL	
		or Pounce 384 EC	520 mL	
		(5) Thiodan 50% WP	5-6.75 kg	Check the label.
		(6) [2]Guthion 50% WP	2.1 kg	
		or [2]APM 50% W	2.1 kg	
		(7) Imidan 50% WP	4.25 kg	Where plum curculio is a problem use one of the materials recommended under PETAL FALL.
		(8) Zolone 30% WP	3.25 kg	
	Blister mite	Use one of:		
		(1) Sevin 50% WP	6.75 kg	
		or Sevin 85% WP	4.25 kg	
		(2) Thiodan 50% WP	3.25-4.5 kg	Check the label.
	Scab	Add one of the fungicides listed under **GREEN TIP.** Reduce rate of Cyprex or Equal to 2.25 kg/ha in cover sprays.		
SUMMER SPRAYS	Psylla (about July 10)	Use one of the materials listed under **PETAL FALL.** See notes.		An additional spray at this time may be necessary where low volume sprays are being applied.
	Mites (about July 15-20)	Use one of		Red mite must be controlled to help prevent leaf scorch and keep foliage on trees. Examine orchards about July 15-20, and, if necessary apply one of the miticides. DO NOT APPLY closer to harvest than days shown. Alternate miticides. Carzol is harsh on beneficial mite species.
		(1) Plictran 50% WP (14 days)	1.25 kg	
		(2) Kelthane AP-35 (7 days)	4.5 kg	
		or Kelthane 187.5 EC (7 days)	8.5 L	
		(3) Carzol 92 SP (1 day)	1.1 kg	
		(4) ethion 25% WP (30 days)	6.75 kg	
SECOND COVER	Psylla Codling moth	Use one of the materials listed under **PETAL FALL** See notes.		
		or Sevin 50% WP	6.75 kg	Sevin is not effective against older psylla nymphs.
		or Sevin 85% WP	4.25 kg	
	Sooty blotch	Add one of:		
		(1) captan 50% WP	6.75 kg	Repeat spray for sooty blotch two weeks later.
		or captan 80% WP	4.25 kg	
		(2) Zineb 80% WP	6.0 kg	
SPECIAL SPRAY About mid-August	Oblique-banded leafroller	(1) Imidan 50% WP	4.25 kg	Where pest has been a problem, consult Horticultural Crop Advisor for proper timing.
		(2) [2]Guthion 50% WP	2.1 kg	
		or [2]APM 50 W	2.1 kg	

[2] *Minimum period before reentry is 48 hours.*

**Repeated applications of synthetic pyrethroids are discouraged. See "Pesticide Resistance", page 8.*

Notes:

1. **Mealybug:** Where this has been a problem — spray at **PETAL FALL** and **FIRST COVER** with [3]parathion 15% WP 1.75 kg per 1000 L. A high-volume spray is necessary for good control.
2. **Mite Control:** Two, early season sprays are necessary for good mite control. Oil is not effective for the rust mite, but those miticides listed for **PREBLOOM** and **PETAL FALL** will control both the rust mite and European red mite.
3. **Dikar WP**: When used in a full season program at 10-day intervals, Dikar at 6.75 kg/ha will control pear scab and nymphal stages of pear psylla. It will also suppress red mite and rust mite populations. It must not be used within 30 days of harvest. Higher water volumes aid in mite suppression. Consult label.

POLLINATION: All varieties in Ontario are commercially self-unfruitful, and mixed plantings are necessary. Insects are required for cross-pollination. Honeybees do not find pear blossoms as attractive as most other fruits. Careful timing of the introduction of honeybees to orchards is necessary. Up to 8 hives per hectare are recommended to be placed when the orchard is about 25% in bloom. The use of pollen inserts will help to overcome this problem. See also page 8.

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[3] *Minimum period before reentry is 7 days.*

GUIDELINES FOR PROTECTING YOUNG NON-BEARING PEAR PLANTINGS

The following program is designed to offer **limited protection when needed for newly planted trees.** It is not intended to be used for protection of bearing orchards. Other protective measures included removal of neglected fruit trees in the area, careful selection of intercrops (where used) and a clean, weed-free environment. Rates are for dilute spraying. Alternate materials are available as shown in the calendar for bearing fruits.

DISEASES AND INSECTS	MATERIALS	AMOUNT PER 1000 L	NOTES
Fireblight	Agri-Mycin 17 100 ppm	600 g	Avoid overstimulating growth. See page 16.
Pear Psylla	Morestan 25% WP	500 g	If nymphs are observed spray when 75% of the petals have fallen in a bearing orchard. Also controls mites.
Leaf-feeding insects	Imidan 50% WP	1.25 kg	Apply at any time when small caterpillars are feeding.
Pear Psylla (summer broods)	Thiodan 50% WP	1.5 kg	Apply when early nymphal stages are present.
European red mite	Plictran 50 W	375 g	Check foliage frequently and spray if more than 5 mites/leaf are observed or at first sign of leaf bronzing.

PLUMS

Read the label and follow all safety precautions. For dilute spraying, refer to page 9, "GUIDE FOR SPRAYING TREE FRUITS"

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
GREEN TIP Just as buds are bursting	Red mite Scale insects	Use one of: (1) superior oil (2) Ethion superior oil	 65.0 L 65.0 L	Spray on a calm day to improve coverage. Apply 3300 L (dilute rate) per hectare.
	Red mite only	Superior Oil Concentrate	17 L	
PREBLOOM When blossoms show white	Brown rot	Use one of: (1) captan 50% WP or captan 80% WP (2) sulfur 90-95% WP (3) Funginex 190 EC (4) Phygon-XL 50% WP or Dichlone 50% WP	 6.75 kg 4.25 kg 20.25 kg 2.5 L 1.75 kg 1.75 kg	To help control brown rot, knock off mummied fruit when pruning. Also, cultivate entire orchard before bloom. Sulfur helps control Eriophyid mites on European plums and prunes. Captan may cause injury, under some circumstances. Injury has occurred on Grand Prize, Early Golden, Shiro, Burbank and Ozark Premier. Make two to three applications from early to full bloom. Do not use Phygon or Dichlone for 5 days after frost. Do not use when temperatures are above 29°C. Do not use within 10-14 days of Bordeaux or oil.
	Black knot	Spray European plums, prunes and Damsons at weekly intervals starting at prebloom. There is no effective fungicide registered for black knot. However, several sprays from the bloom period through first cover of Benlate 50% WP at 1.1 kg/ha (full rate) tank mixed with captan 50 WP at 4.25 kg controls 'brown rot' where strains resistant to Benlate are not present, and has greatly reduced black knot. (See note on black knot, page 49.)		
DO NOT APPLY INSECTICIDES WHEN PLUM TREES ARE IN BLOOM. See note on Pollination page 8.				
PETAL FALL When last of petals are falling	Red mite	Use one of: (1) Kelthane AP-35 or Kelthane 187.5 EC (2) Omite 30 W	 4.5 kg 8.5 L 5.5 kg	See note on **RED MITE** control at end of Plum calendar. Requires temperature above 21°C to be effective.
SHUCK When most of the shucks are off	Brown rot	Use one of: (1) Sulfur 90-95% WP (2) Captan 50% WP or captan 80% WP	 20.25 kg 6.75 kg 4.25 kg	Captan can cause leaf injury and spotting of the fruit on Japanese plums under some circumstances.
	Plum Curculio	Add one of: (1) [2]Guthion 50% WP or [2]APM 50 W (2) methoxychlor 50% WP (3) Imidan 50% WP (4) [3]parathion 15% WP (5) Zolone 30% WP	 2.0 kg 2.0 kg 10.0 kg 4.25 kg 3.25 kg 3.25 kg	If temperatures are high, spray when the shucks split. Zolone will also control aphids

SHUCK	Red mite	Add one of: (1) Kelthane AP-35 or Kelthane 187.5 EC (2) Omite 30% W	 4.5 kg 8.5 L 5.5 kg	If oil was not used at **GREEN TIP**, a second spray for mites is due at this time. See note on **RED MITE** at the end of Plum calendar.
FIRST COVER 12 days after **SHUCK**	Brown rot Leaf spot	Use one of the fungicides listed under **SHUCK**.		
	Plum curculio	Use one of the insecticides listed under **SHUCK**.		
SUMMER SPRAY	Red mite	Use one of the miticides listed under **SHUCK**.		See note on **RED MITE** at the end of Plum calendar.
The addition of Benlate 50% WP at 850g plus captan 50% WP at 4.25 kg/ha will improve brown rot control only where the fungus is not resistant to Benlate.				
SECOND COVER	Brown rot	Use one of: (1) sulfur 90-95% WP (2) Captan 50% WP or captan 80% WP	 20.25 kg 6.75 kg 4.25 kg	During wet weather repeat applications between pickings. Check interval to harvest for materials. See page 14.
PRE-PICK	Brown rot	Use one of the fungicides listed under **SECOND COVER.**		Check interval to harvest for materials.

[2]Minimum period before reentry is 48 hours

[3]Minimum period before reentry is 7 days

**Repeated applications of synthetic pyrethroids are discouraged. See 'Pesticide Resistance', page 8.*

Notes:

APHIDS: If aphids are a problem, spray with one of:

1. Thiodan 50% WP 3.25 kg/ha;
2. diazinon 50% WP 3.25 kg/ha;
3. Zolone 30% WP 3.25 kg/ha.

Very thorough coverage and calm, warm conditions are needed for good control.

PEACH TREE BORER: If a problem, spray as directed for **PEACHES**, see page 41.

POLLINATION: Both European and Japanese plums should be considered as self-unfruitful. Mixed plantings and insect pollinators are essential. Honeybees readily work plum blossoms.

BLACK KNOT: Destroy affected wild plums and neglected plums near orchard. Cut out and burn all black knots before March. Make the cut 15 cm below the swelling. Collect and burn all prunings bearing knots. **Knots left lying on the ground are a source of spores that start new infections.** Inspect all plums in early summer for new knots and those that were missed. Cut these out and burn them. Apply prebloom spray to all Damsons, European type plums and prunes.

APPLE MAGGOT: Where it has been a problem on prune, apply two or three sprays at 10-day intervals during July and early August. Consult Spray Service Circulars or Agri-phone for more details. Spray with one of:

1. diazinon 50% WP 3.25 kg/ha
2. [2]Guthion 50% WP 2.0 kg/ha or [2]APM 50 W 2.0 kg/ha
3. Imidan 50% WP 4.25 kg/ha
4. Zolone 30% WP 5.0 kg/ha

[2]Minimum period before reentry is 48 hours

HEAT SPOT: High temperatures may cause purplish spots on plum and prune fruits which exude clear gum. The spots develop about five to eight days after the hot spell. Summer cover crops and mulch help to reduce this physiological disease.

Spraying with 4 kg/1000 L calcium chloride in mid-July and in early August has been demonstrated to reduce this disorder on prunes. Three sprays, 10-12 days apart, should be applied.

RED MITE: Mite control is difficult on plums and especially on prune varieties. Apply **GREEN TIP** and **PETAL FALL SPRAYS,** or **PETAL FALL** and **SHUCK SPRAYS,** using the recommended miticides. **SUMMER SPRAY** about mid-July, if mites are found on leaves of susceptible varieties (especially prunes); spray thoroughly with one of the miticides listed after first cover but not closer than the number of days allowed before harvest.

RASPBERRIES AND BLACKBERRIES

Do not use Guthion, Phosdrin, or Systox in knapsack or other home garden-type sprayers.
Read the label and follow all safety precautions.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	AMOUNT PER 1000 LITRES	NOTES
	Do not spray closer to harvest than the number of days given in brackets. Unless otherwise stated use at least 2000 L of water per hectare.				
QUARTER-INCH GREEN	Anthracnose and Spur blight	DNOC liquid (Elgetol)	17.0 L	10 L	Use 1500 L of water per hectare. This is the primary component of a good control program
PREBLOOM until blossoms open.	Anthracnose and Spur blight	ferbam 76% WP	4.5 kg	2.25 kg	Continuous coverage of new growth is essential through the bloom period.
	Powdery mildew	Use one of: (1) Benlate 50% WP (1 day) (2) Easout 70% WP (1 day)	 1.1 kg 1.1 kg	 550 g 550 g	In problem patches, spray when mildew is first observed. Repeat in 7 to 10 days. See page 7.
	Plant bug	[2]Guthion 50% WP (7 days)	1.5 kg	750 g	Repeat in 10 to 12 days.
	Raspberry sawfly	Rotenone 5% WP (1 day)	11.0 kg	4.0 kg	Repeat in 7 to 10 days.
	Raspberry fruitworm	malathion 25% (1 day)	4.5 kg	2.25 kg	Repeat in 7 to 10 days when bees are not working in the patch.
SEE PAGE 9 FOR WAYS TO REDUCE BEE POISONING.			**POLLINATION: These crops are self-fruitful but insects assist in pollination. The blossoms are highly attractive and are readily visited by honeybees.**		
BLOOM	Fruit rots on raspberries	Use one of: (1) captan 50% WP (2 days) or captan 80% WP (2 days) (2) Benlate 50% WP (2 days) plus captan 50% WP	 4.5 kg 3.25 kg 1.1 kg 4.5 kg	 2.25 kg 1.75 kg 550 g 2.25 kg	Repeat every 7 to 10 days to harvest. Because fungus can become resistant to Benlate, captan is recommended.
SPECIAL SPRAYS When insects or mites first appear. Repeat as necessary.	Leafhoppers	Use one of: (1) [2]Guthion 50% WP (7 days) (2) [1]Phosdrin (3 days) (3) malathion 25% WP (1 day)	 1.5 kg 550 mL 4.5 kg	 750 g 275 mL 2.25 kg	Do not spray with insecticides when bees are working on berry blossoms.
	Two-spotted spider mite	Kelthane 187.5 EC (7 days)	9.0 L	4.5 L	
POSTHARVEST SPRAY As soon as crop harvest is complete.	Powdery mildew	Use one of: (1) Benlate 50% WP (2) Easout 70% WP	 1.1 kg 1.1 kg	 550 g 550 g	 Repeat at 14-day intervals. Repeat at 14-day intervals.

POSTHARVEST SPRAY (continued)	Anthracnose and Spur blight	ferbam 76% WP	4.5 kg	2.25 kg	Remove and destroy old canes immediately after harvest.
	Aphids	[2]Systox 240 EC	3.0 L	1.5 L	Aphids spread virus diseases. May also control two-spotted spider mite.
	Two-spotted spider mite	(1) [2]Systox 240 EC (2) Kelthane 187.5 EC	3.0 L 9.0 L	1.5 L 4.5 L	

[1] Minimum period before reentry is 24 hours.
[2] Minimum period before reentry is 48 hours.

OTHER INSECTS AND DISEASES

1. **Viruses:** Virus diseases such as mosaic and leaf-curl are the main causes of low yields and poor quality fruit. The following steps will help minimize virus spread:
   a. Plant virus-tested certified stock.
   b. Destroy all nearby wild raspberries and blackberries.
   c. Set new plantation at least 16.0 m from older plantations. Red raspberries should not be planted close to purple and black raspberries.
   d. Rogue out and completely destroy all virus-infested plants as soon as symptoms of mosaic or leaf-curl appear.
2. **Cane Borer:** Canes girdled with two rings one-half inch apart. Examine canes frequently in June and July. Cut off wilted tips below lower ring, as they appear.
3. **Crown Gall:** Do not plant canes affected with crown gall. Avoid injury to crown and roots. Maintain high soil fertility.
4. **Orange Rust of Blackberry:** Bright orange pustules appear on lower surface of leaves. Dig out and destroy infected plants early in the spring before pustules break open.
5. **Sap Beetles:** Black beetles with cream markings infest berries in boxes. No chemical sprays give satisfactory control. Never put boxes of berries on ground. Remove from planting to screened building or shelter immediately after picking. For small plantings, use baits consisting of: (a) apple cider vinegar (1 L) plus 1 teaspoonful of either Sevin or Thiodan and place in small wide-screened jars throughout planting. Renew bait every few days; (b) mashed bananas or chopped up immature sweet corn and mixed with Thiodan 50% WP at the rate of 500 g per 25 kg; (3 level tablespoons per 1.0 kg) of ground material. Place bait on disposable pieplates (about 100 g per plate) and cover with second perforated plate. Distribute traps at 16.0 m intervals. Renew with fresh bait each week. Dispose of old bait and used pieplates by burying. KEEP BAIT OUT OF REACH OF CHILDREN, PETS AND LIVESTOCK.
6. **Verticillium Wilt (bluestem):** Do not plant following tomatoes, potatoes, eggplants, or peppers and do not interplant with these crops.
   Red raspberries: Cut out and destroy infected canes. Black and purple raspberries: Dig out and destroy infected plants.
   See page 70 for preplanting soil fumigation treatment.
7. **Cane Blight:** Canes wilt and die just before fruiting. Canes grayish. Most prevalent on canes weakened by insect and winter injury.
8. **Winter Injury:** Provide good drainage. Sow cover crop to check late growth. Do not cut canes back in fall.
9. **Nematodes:** Stunted, straggly canes. See page 70.
10. **Raspberry Crown Borer:** If more than 5% of the crowns are infested, apply a drench to the crown area. Infested planting should be treated for at least two years running.
    Fall Treatment: Mid-September — mid-October: Drench crown area using Diazinon 500 EC 1.0 L (50% WP — 1.0 kg) per 1000 L of water. Apply 4000-5000 L of spray mixture per hectare. **Spring Treatment:** When new growth appears: apply treatment as above.
11. **Phytophthora Root Rot of Raspberry:** A newly recognized disease complex characterized by patches of dying or stunted canes with yellow leaves and small fruits. Previously these symptoms were attributed entirely to wet soil conditions and/or winter injury. Diseased canes have major roots with a distinct margin between the reddish-brown infected tissue and green healthy tissue, which may extend half way around the root and run along its length.
    Chemical Control for New Planting Only: Use 150 mL of †Ridomil 240 EC as a drench treatment to 100 m of row, 1 m wide, centred over the row. Apply in the spring after planting, and again in the fall (mid October to late November). Drench with at least 5000 L of water per hectare.

OTHER CULTURAL PRACTICES RECOMMENDED

a. Immediately when harvest is finished, remove and burn old canes, plus diseased and spindly new canes.
b. Plant on well-drained soil and on a site with good air circulation.
c. Space rows at least 2.5 m apart. Limit width to 0.5-0.6 m. Do not allow planting to become too dense.
d. Keep rows free from weeds.
e. In spring prune out and burn canes or portions of canes showing swelling, scars or cracks.

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† See "Temporary Registration of Pesticides" inside front cover.

STRAWBERRIES

Read the label and follow all safety precautions. **When spraying, use enough water to thoroughly wet plants.**

NEW PLANTING:

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
IN THE FALL BEFORE PLANTING	Verticillium wilt Nematodes	(1) Vorlex (2) Vapam	225 to 450 L 550 to 900 L	Treatment costly. Soil should be in seedbed condition, plant debris well-rotted, and soil temperature at 4°C or higher. Cultipack or irrigate to seal the soil surface. See page 70.
	Nematodes only	Use one of: (1) Vorlex (2) Telone II B	55 to 130 L 170 L	See page 70.
IN SPRING BEFORE PLANTING	White grub Wireworm	chlordane	1.1-2.25 kg (active) soil treatment, banded, apply at planting time.	**DO NOT PLANT STRAWBERRIES FOLLOWING SOD** since white grubs and wireworms are likely to be prevalent. **BECAUSE OF ROOT WEEVILS,** avoid planting strawberries adjacent to older plantings, particularly if fairly well-defined areas of stunted plants have been noted in these plantings. They may be infested with strawberry root weevil. Chlordane should be effective in controlling all three insects. Apply sprays in sufficient water to get good coverage. Disk into a depth of 10 to 13 cm immediately after application. Granular formulations may be drilled into the soil to a depth of about 10 cm.
	Root weevil	chlordane	5.5-11.0 kg (active). Broadcast: apply before planting, and work into the top 7-15 cm of soil.	
Set out only vigorous, healthy certified plants, apparently free of June yellows and viruses.				
AFTER PLANTING	Cutworms	Use one of: (1) Sevin 50% WP or Sevin 85% WP (2) Poison bait	2.25 kg 1.25 kg	**POISONED BAIT:** Thoroughly mix bran, 11 kg with Sevin 50% WP at 900 g or Sevin 85% WP at 540 g. Then moisten with water, about 10 L and mix thoroughly. Broadcast freshly prepared bait at dusk on a warm evening at 9 to 11 kg/ha. Sprays of Sevin will control above ground cutworms only.
1st or 2nd WEEK IN JUNE and again between AUG. 15 and AUG. 25	Strawberry leafroller Leafhopper	Use one of: (1) ^{3}parathion 15% WP (2) ^{2}Guthion 50% WP or ^{2}APM 50 W (3) malathion 25% WP	1.75 kg 1.5 kg 1.5 kg 4.5 kg	Use sufficient water to wet plants thoroughly. Repeated applications will be necessary for leafhopper control.

ONE MONTH AFTER PLANTING and again ONCE OR TWICE AT 2-WEEK INTERVALS	Blight Scorch Leaf spot	Use one of:		Spray all varieties where Scorch has been a problem.
		(1) bordeaux	5-5-1000 L	Use sufficient water to wet plants thoroughly.
		(2) Cyprex 65% WP	1.75 kg	Cyprex or Equal may injure Earlidawn plants. For instructions on mixing Bordeaux see page 17.
		or Equal 65% WP	1.75 kg	
FALL	Red Stele	†Ridomil 240 E	4.2 L	This application is only necessary where there has been a history of Red Stele. Consult your Horticultural Crops Advisor. One application should be made in early September, and a second treatment in early November. Apply as a broadcast application in sufficient water to ensure even coverage. If dry conditions prevail at time of application use sufficient water volume (2500 L/ha) to ensure movement of †Ridomil into root zone. These treatments may be applied to new plantings **only**.

BEARING PLANTS (See Guidelines for Spraying Strawberries page 55)

DO NOT SPRAY closer to harvest than the number of days indicated in brackets following materials (see Table 5).

FIRST SPRAY WHEN BUDS ARE VISIBLE IN CROWN	Blight Scorch Leaf spot	Use one of:		
		(1) bordeaux	10-10-2000 L	Do not use with insecticides listed below.
		(2) Cyprex 65% WP (7 days)	1.75 kg	Cyprex or Equal may injure Earlidawn plants. For instructions on mixing Bordeaux see page 17..
		or Equal 65% WP (7 days)	1.75 kg	
	Fruit rot (Botrytis)	Use one of:		
		(1) captan 50% WP (2 days)	6.75 kg	
		or captan 80% WP (2 days)	4.25 kg	
		(2) Dyrene 50% WP (5 days)	3.25 kg	Dyrene may cause foliage injury if used soon after a frost. Early season spraying is essential. Spray every 7 to 10 days. Reduce interval to three to five days during rainy periods. Captan gives short residual control under wet conditions.
		(3) Rovral 50% WP (1 day)	2.0 kg	Do not use Rovral in consecutive sprays or more than two sprays per season. Alternate with other fungicides.
		(4) Phaltan 50% WP (1 day)	2.25 kg	
	Strawberry Clipper Weevil	Use one of:		Strawberry weevil may be active in the spring before mulch is removed
		(1) [2]Furadan 480 F	1.1 L	
		(2) [2]Guthion 50% WP	1.1 kg	Use Furadan not later than first bloom because of its toxicity to pollinating insects.
		(3) malathion 25% WP	6.75 kg	Furadan may remain toxic to beneficial insects for at least 10 days. Use Furadan only once during the season.

[2] *Minimum period before reentry is 48 hours.*

[3] *Minimum period before reentry is 7 days.*

† *See "Temporary Registration of Pesticides" inside front cover.*

STRAWBERRIES (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	NOTES
ABOUT FIRST WEEK IN MAY	Spittle bug	Use one of: (1) ^{2}Guthion 50% WP (5 days) or ^{2}APM 50 W (5 days) (2) ^{1}Phosdrin (1 day) (3) Thiodan 50% WP (7 days)	 1.1 kg 1.1 kg 550 mL 1.1 kg	Guthion will also control strawberry weevil (blossom clipper). If spittle masses are already numerous, use Thiodan or Phosdrin.
WHEN FIRST BUDS SHOW WHITE	Fruit rot (Botrytis)	Use one of the fungicides listed for fruit rot in the **FIRST SPRAY.**		
	Strawberry Clipper weevil	Use one of: (1) ^{2}Guthion 50% WP (5 days) (2) malathion 25% WP (3 days) (3) methoxychlor 50% WP (14 days)	 1.1 kg 6.75 kg 4.50 kg	Use methoxychlor if blossoms have already opened.
		POLLINATION: Most varieties are self-fruitful but insects do assist in pollen transfer. Honeybees are excellent pollinators.		
FIRST BLOOM	Plant bugs	Use one of: (1) Cygon 480 E (2) Thiodan 50% WP (3) ^{1}Phosdrin	 2.75 L 2.25 kg 550 mL	**DO NOT SPRAY WHEN BEES ARE WORKING, SPRAY IN EVENING.** See page 9 for ways to reduce bee poisoning. If strawberry leafroller is a problem, use Phosdrin. Repeat in seven days.
	Fruit rot (Botrytis)	Use one of the fungicides listed for fruit rot in the **FIRST SPRAY.**		Keeping all flower parts coated with fungicide during bloom is essential to good control of Botrytis.
7 TO 10 DAYS AFTER FIRST BLOOM and REPEAT 7 TO 10 DAYS LATER	Plant bugs	Use one of: (1) Thiodan 50% WP (7 days) (2) ^{1}Phosdrin (1 day)	 2.25 kg 550 mL	**DO NOT SPRAY WHEN BEES ARE WORKING, SPRAY IN EVENING.** See Page 9 for ways to reduce bee poisoning.
	Fruit rot (Botrytis)	Use one of the fungicides listed for fruit rot in the **FIRST SPRAY.**		Shorten intervals to three days if weather is wet.
TO END OF HARVEST	Fruit rot (Botrytis)	Use one of: (1) captan 50% WP (2 days) or captan 80% WP (2 days) (2) Rovral 50% WP (1 day) (3) Phaltan 50% WP (1 day)	 6.75 kg 4.25 kg 2.0 kg 2.25 kg	If irrigation is necessary, water early in the day to allow plants to dry off before nightfall. Do not use Rovral in consecutive sprays or more than two sprays per season. Alternate with other fungicides.
	Leathery Rot (Phytophthora)			See note 4 at end of strawberry calendar.

	Slugs	Metaldehyde bait		Distribute along edge of rows but not on strawberry plants. Keep domestic animals and birds from treated areas. Read label re: poisoning. Very poisonous to dogs.
RENOVATION Immediately after harvest	Root weevils when root weevil damage is evident in the field	chlordane	3.25 kg (active)	Repeat in three weeks. Do not apply chlordane again to the same field for at least four years.

[1]Minimum period before reentry is 24 hours. *[2]Minimum period before reentry is 48 hours.*

OTHER PESTS:

1. **Two-spotted mite:** Spray to cover undersides of leaves thoroughly at first sign of this mite and repeat application at 7-day intervals. Use one of Kelthane AP-35 (dicofol) 2.75 kg (2 days); [1]Phosdrin (mevinphos) 550 mL (1 day); ethion 25% WP 2.25 kg (8 days); Plictran 50 W 2.25 kg (7 days) per hectare.
2. **Leafhoppers:** When leafhoppers first appear, spray with [1]Phosdrin (mevinphos) 550 mL (1 day) per hectare.
3. **Strawberry root weevil:** This is not the same insect as the strawberry weevil that clips the blossoms in the spring. Since the adult cannot fly, isolation of the new strawberry planting from older planting should provide protection. Chlordane as recommended for white grub and wireworm should provide control.
4. **Leathery rot (Phytophthora):** The use of captan or Phaltan has been observed to reduce the incidence of leathery rot although they are not currently registered for control of this disease. Leathery rot is worse under cool, wet harvest conditions. A straw mulch thick enough to prevent soil splash onto berries will greatly reduce leathery rot.
5. **Powdery Mildew:** Renovate old plantings immediately after harvest. If a problem in new plantings, apply Benlate 50% WP at 1.1 to 1.75 kg/ha.
6. **Cyclamen mite:** Spray with Thiodan (50% endosulfan WP) 2.2 kg (7 days) in 1000 L of water, and apply at 5000 to 8000 L of spray per hectare. Plow under old plantings. DO NOT plant new plantings adjacent to older plantings. Consult your Horticultural Crop Advisor or Pest Management Specialist.

GUIDELINES FOR SPRAYING STRAWBERRIES

To find the nozzle size for a boom sprayer do the following:

1. Divide the number of square metres per hectare by the swath width.

$$\frac{10{,}000\text{ (square metres)}}{\text{width (metres)}} = \text{travel distance (metres per hectare)}$$

2. $$\frac{\text{Travel distance (metres per hectare)}}{\text{Travel speed (metres per minute)}} = \text{spraying time (minutes per hectare)}$$

3. $$\frac{\text{Litres per hectare}}{\text{Minutes per hectare}} = \text{Litres per minute (for all nozzles)}$$

4. $$\frac{\text{Litres per minute}}{\text{Number of nozzles}} = \text{Litres per minute per nozzle}$$

5. From manufacturers' charts (see pages 41-47, publication 373, Orchard Sprayers), choose a nozzle to give this output at the desired pressure. Further guidance is found in the section on "Strawberries."

Results from a recent sprayer assessment show that several factors contribute to poor control of botrytis rot of blossoms and berries.

1. Foliage that is very tall and dense keeps the humidity high and promotes rot.
2. Very wide rows and narrow spaces cause poor aeration and slow drying.
3. Booms having all nozzles above the crop give poor penetration and light deposits on lower surfaces of leaves and on calyxes of blossoms.
4. Air-blasts row-crop sprayers spray well only the first three rows. Sides away from the sprayer get poorer coverage.
5. Conjet air-shear sprayer with drive nozzles penetrates well, especially when drop arms are used.
6. Drop arms on boom sprayers improve coverage greatly.
7. Speeds greater than 3 km/h with boom sprayers give poorer coverage.

FERTILIZER AND SOIL MANAGEMENT — FRUIT CROPS

General Considerations

Leaf analysis is the best method of determining nutrient needs in established fruit trees and grapes. Prior to planting the orchard, vineyard or strawberry plantings soil tests are recommended. Soil pH (acidity) should also be checked, particularly in the parts of the orchard where nitrogen fertilizer is applied. Leaf analysis service and soil testing services are offered by the Ontario Ministry of Agriculture and Food with information supplied by your local Horticultural Crop Advisor.

Leaf analysis most accurately reflects the uptake of nutrients by the trees or vines. Nutrient uptake is affected by all orchard conditions including nutrient and moisture supply. Consequently, each year the actual amounts present will be slightly higher or lower depending upon the season. In order to obtain optimum growth and fruit quality adequate levels of the nutrients must be present in the leaves and the relative amounts must be balanced. For example, with McIntosh optimum fruit storage quality is obtained when the amount of leaf nitrogen is 2.1% and the ratio of nitrogen relative to potassium is 1.25. A higher ratio indicates excessive nitrogen whereas a lower ratio may be reflected in poor terminal growth, light foliage, reduced fruit size and crop.

Even with optimum levels of nitrogen or potassium poor growth can be attributed to low levels of magnesium, boron, zinc or other micronutrients which will be reflected in the leaf analysis. For leaf analyses to be most effective, the same trees should be sampled each year and yearly adjustments made to the fertilizer program on the basis of leaf analyses, growth, fruit size, color and storage quality, etc. Some growers sample every third year to monitor the effectiveness of their fertilizer program. (Further information is available on the current Factsheet on Leaf Analysis.)

Soil sample boxes and information sheets for leaf and soil may be obtained from local offices of the Ministry of Agriculture and Food or from Agri-Food Laboratories, 503 Imperial Road, Unit One, Guelph, Ontario N1H 6T9.

Fertilizers are guaranteed in terms of N (elemental nitrogen), P_2O_5 (phosphate) and K_2O (potash). In the following pages, fertilizer rates will be suggested in terms of N, P_2O_5 and K_2O. The amount of fertilizer material to apply can be determined by multiplying the N, P_2O_5 or K_2O needed by 100 and then dividing by the % of that element contained in the fertilizer material.

Nitrogen

Most bearing orchards require annual applications of nitrogen fertilizer. However, certain precautions must be observed. Fruit trees need ample amounts in the spring to start vigorous growth. If too much nitrogen is applied, or if it is applied too late in the season, fruit color and quality may be poor. While this is particularly serious for apples that are kept in long term storage, it is also true of other fruits, including peaches. Excessive nitrogen, therefore, must be avoided late in the season. Nitrogen should be applied in early April to allow proper utilization. Urea has been successfully applied in late fall, but more nitrogen may be required than in the spring.

The use of cover crops in cultivated orchards will help to lower the nitrogen level in the latter part of the season. Cover crops such as Italian ryegrass, sown about July 1 in orchards or August 1 in vineyards, will take up much of the available nitrogen in the soil and in this way have a desirable effect in checking tree growth.

In herbicide-treated strips under trees, weed growth late in the season will take up extra nitrogen and assist in hardening off trees and improving fruit quality. Mouse control must be part of the management system.

Table 8 indicates the percentage of nitrogen desired in mid-shoot leaves collected from bearing fruit trees after the terminal bud has formed in mid-July or in grape petioles collected in September.

TABLE 8. NITROGEN LEVELS IN MID-SHOOT LEAVES OF FRUIT TREES TAKEN THE LAST 2 WEEKS OF JULY AND IN GRAPE PETIOLES TAKEN IN SEPTEMBER.

Tissue Samples	Percentage Nitrogen Low — Less than	Optimum Range	High — Above
Apple Leaves			
a. Delicious, Paulared, Tydemans, Scotia, Mutsu	2.2	2.2-2.7	2.7
b. Spy, Russet, Empire	2.1	2.1-2.6	2.6
c. McIntosh and other varieties	2.0	2.0-2.5	2.5
Peach Leaves			
a. Most varieties	3.4	3.4-4.0	4.0
b. Sunhaven, Babygold 7, Candor, Velvet, Harbelle	3.5	3.5-4.1	4.1
c. Redskin, Harbinger, Harbrite, Vivid	3.3	3.3-3.9	3.9
Pear Leaves			
a. Bartlett	2.0	2.0-2.6	2.6
b. Bosc and Clapp	2.1	2.1-2.7	2.7
c. Flemish Beauty	2.2	2.2-2.8	2.8
Montmorency Cherry Leaves	2.2	2.2-2.9	2.9
Grape Petioles			
a. Most varieties	0.7	0.7-1.3	1.3
b. De Chaunac, Foch, Baco Noir, Verdelet, S Blanc, Vydal	0.8	0.8-1.4	1.4
c. President, Fredonia, Niagara, Catawba	0.6	0.6-1.2	1.2

Note:

1. For non-bearing trees the nitrogen levels shold be 0.2% higher.
2. For apples on M9 and M26 rootstocks nitrogen levels should be 0.2% higher.

Nitrogen Rates

The best guide to rates, as already suggested, is tree growth and behavior, fruit yield, color and quality, variety, type of management and nutrient balance in your soil. However, as a general rule of thumb *for cultivated orchards*, the following rates could be considered normal. For each year of the tree's age, apply between 15 and 20 g of N (45-60 g ammonium nitrate or 33-45 g urea or 90-120 g calcium nitrate). Thus a 20-year-old tree in a cultivated orchard would require 400 g N (1.2 kg ammonium nitrate or 0.9 kg urea or 2.4 kg calcium nitrate). Use the most economical source of nitrogen based on cost per unit of N (actual nitrogen).

For unmulched sod orchards, immediately following sod establishment, the rates should be doubled. If the orchard is mulched, the need for nitrogen will vary depending on the kind of sod and the mulch being used. Between 30 and 40 g N per year of a tree's age should be applied.

Suggested maximum rates of nitrogen application in cases of severe deficiency are 1.5 kg N per tree or equivalent for mature seedling apple or sweet cherry trees in sod, and 0.75 kg nitrogen per mature tree in cultivation. For cultivated mature peach and sour cherry trees a maximum of 0.75 kg N per tree is suggested. Mature pear and plum orchards in sod should not receive more than 1.25 kg N per tree.

Varieties differ in their nitrogen requirements. For example, a variety grown for processing could receive more nitrogen than one for fresh market. If fruit size tends to be small, more nitrogen may be needed. Rootstock, spacing and pruning also have an influence. When the tree canopy has covered the space available, nitrogen fertilizer requirements will level out and will not increase indefinitely with tree age. Again, leaf analysis is the most reliable guide.

A spring application of 35 kg N/ha broadcast on the sod, in addition to the application required by the trees, will encourage sod growth.

More information on specific crops is given on the pages which follow.

Nitrogen Placement

In cultivated orchards nitrogen should be broadcast under the tree canopy. In sod orchards the nitrogen should be placed in a band under the drip line or in the herbicide strip to be more effective. On young trees the fertilizer should be broadcast at least 15 cm from the trunk, under the spread of the branches.

Nitrogen Equivalent Table

Different fertilizer materials supply different amounts of N. Examples are shown in Table 9. For example, 44 kg of ammonium nitrate is equivalent to 97 kg calcium nitrate, or 33 kg urea.

TABLE 9. AMOUNT OF NITROGEN FERTILIZERS REQUIRED TO SUPPLY SPECIFIC AMOUNTS OF NITROGEN

Nitrogen kg actual	Ammonium Nitrate (34% N) kg	Urea (45% N) kg	Potassium Nitrate (13% N) kg	Calcium Nitrate (15.5% N) kg
5.0	15	11	38	32
10.0	29	22	76	64
15.0	44	33	115	97
20.0	59	44	154	130
30.0	88	67	230	194
40.0	118	89	308	259

In deciding what nitrogen fertilizer to use, calculate the cost per unit of actual nitrogen (N). Under most conditions, the fertilizer which costs least per unit of actual nitrogen should be used. This may not be the cheapest per tonne of fertilizer. Soil application of urea to sod orchards is not recommended since some of the nitrogen may be lost from the urea by volatilization.

Foliar applications of urea (45% nitrogen) have been used successfully on apples and strawberries, when weather or crop conditions resulted in a need for additional nitrogen at a critical time. They are not generally recommended. Late application on apples may adversely affect quality. On apples, use no more than 2.7 kg N per 1000 L (6 kg urea) and apply at least 2000 L/ha starting with the first cover spray, and spacing the sprays about 10 days apart. Do not apply more than three times. On low-nitrogen, fruiting strawberry plantings, apply at the same rate as for apples, at weekly intervals until the harvest is near completion.

Do not rely on urea sprays to completely substitute for soil applications if nitrogen is required. Under some conditions nitrogen starvation of woody tissue can occur leading to poor fruit set and fruit development.

N and K can be applied together in a single mix of the required quantities of each. Be sure that materials are well mixed and do not separate during application.

Potassium (K)

Potassium is an important nutrient for tree fruits and grapes. It is frequently required in Ontario orchards and vineyards.

The concentration of K and Mg found in leaf and petiole samples given in Table 10 are guidelines to be used in determining the nutrient status of orchards and vineyards.

Muriate of potash can be applied separately or combined with nitrogen in the early spring. In sod orchards it should be applied in a band around the drip line and in cultivated orchards it may be broadcast before the first cultivation. Fall application is preferred by some orchardists because of time constraints in spring but some of the potash may be lost by leaching over winter. Early spring application is preferred. If leaf analysis data are not available, apply 50 g K_2O per 2.5 cm trunk cross-section. No more than 3 kg of K_2O (5 kg muriate of potash) should be applied per mature tree in a year.

CAUTION: On young trees, especially on sandy soils, trunk and root damage may occur if the fertilizer is applied in a narrow band or too close to the trunk.

Magnesium (Mg)

Magnesium deficiency is becoming more evident in orchards, and vineyards, particularly in eastern Ontario or when high rates of potash are used. Magnesium deficiency of grapes is also occurring more frequently. Foliar application of magnesium sulfate (epsom salts) is effective in controlling this deficiency on high lime soils.

At least 3.8 kg Mg/ha (40 kg magnesium sulfate) should be applied at each time of application. For dilute application, use 1.9 kg Mg/1000 L with at least 2000 L/ha. Do not exceed 3.8 kg magnesium/1000 L. Fruit or foliage injury is possible from a mixture of pesticides with magnesium sulfate. Mixtures with Cyprex, Captan, Benlate and Polyram, Imidan and Sevin have been applied to apples with no foliage or fruit injury. However, growers would be wise to try mixtures on a few trees before spraying a complete orchard. Magnesium chelates can be safely combined with pesticides and should be applied at a rate of 0.3 kg Mg/ha at each application.

Magnesium sprays should be applied, starting around the calyx period for apples and ealry July for grapes, continuing on a bi-weekly schedule until the three sprays are applied.

TABLE 10. POTASSIUM (K) AND MAGNESIUM (MG) LEVELS IN MID-SHOOT LEAVES OF FRUIT TREES TAKEN THE LAST 2 WEEKS OF JULY AND IN GRAPE PETIOLES TAKEN IN SEPTEMBER

	% Potassium			% Magnesium		
	Low	Optimum	High	Low	Optimum	High
	Less Than		Above	Less Than		Above
Apple leaves	1.3	1.3-2.0	2.0	0.25	0.25-0.35	0.35
Peach leaves	2.0	2.0-3.3	3.3	0.40	0.40-0.80	0.80
Pear leaves	1.3	1.3-2.0	2.0	0.25	0.25-0.50	0.50
Montmorency Cherry leaves	1.5	1.5-2.1	2.1	0.35	0.35-0.85	0.85
Grape Petioles*						
a. Most varieties	1.0	1.0-2.0	2.0	0.60	0.60-1.5	1.5
b. Agawam, Foch, Dutchess, Baco Noir	1.1	1.1-2.2	2.2	0.60	0.60-1.5	1.5
c. Villard Noir, De Chaunac, P. Chardonnay Delaware, Riesling, President, Gamay	1.2	1.2-2.3	2.3	0.60	0.60-1.5	1.5
d. Concord, Elvira, Catawba, Veeport, Vincent, Ventura	0.8	0.8-1.8	1.8	0.60	0.60-1.5	1.5

* *K levels will be higher and Mg levels lower in vines grown on sandy loam soils.*

Soil applications of magnesium in combination with foliar application may give a longer lasting effect. Sulfate of potash-magnesia may be applied when both potash and magnesium are required. Dolomitic limestone should be used to supply magnesium on acid soils as it is an excellent source and is economical.

Phosphorus (P)

Phosphorus is not required in large amounts by fruit trees but sod and cover crops require both phosphorus and potassium which can be broadcast on the orchard floor. Soil tests are required to determine the P requirement of cover crops.

Calcium (Ca)

Spray applications of calcium are effective in reducing bitter-pit in Northern Spy and other apple varieties susceptible to this disorder. Calcium chloride supplying 1.8 kg Ca/1000 L (5 kg calcium chloride) or calcium nitrate supplying 1.4 kg Ca/1000 L (7 kg calcium nitrate) can be used starting in mid-July and at two-week intervals for at least three sprays. At least 2000 L/ha should be applied at each application. DO NOT CONCENTRATE CALCIUM SPRAY.

Ca chelates have been found to be effective in supplying calcium to apples providing sufficient Ca is applied. A rate of at least 0.3 kg Ca/ha (5 L of 6% Ca chelate) should be applied. The more calcium that can be applied the better the control.

Calcium has also been related to gummosis of Italian prune and bunch stem necrosis of certain grape varieties. Spray application of calcium has reduced the extent of these disorders.

Lime

In recent years a trend to lower soil pH has been noted, particularly in tree rows. If the soil pH in established orchards is above 6.0, lime is not needed. In established orchards, when the pH on clay loam soils drops below 5.1, and on sandy loam soils below 5.6, lime should be applied. This will raise the soil pH (reduce the acidity) and also supply calcium. Dolomitic lime (high in magnesium) should be used on soils low in magnesium. Rates of application will vary with soil type and initial pH.

Lime will be much more effective if it is incorporated into the soil. Incorporation prior to orchard planting is the preferred method of adjusting the pH. Lime should be applied at this time to clay loam soils when the pH is below 5.6 and to sandy loam soils when pH is below 6.1. See Table 11. The amount of lime required depends on the clay and organic matter content of the soil. The soil pH is used to determine which soils need to be limed. A separate soil test, the buffer pH test, is done on soils needing lime to determine the actual amount of lime required. For soils needing lime, Table 11 may be used to determine the tonnes of lime required to reach a certain target pH value.

Micronutrients

Deficiencies of micronutrients or trace elements are not widespread in Ontario fruit plantings. Boron deficiency is the most common. Deficiencies of zinc, manganese and iron may show up occasionally, particularly in alkaline soils.

The range between enough and too much is very small for micronutrients. Many of them are more harmful in excess than in deficiency. For this reason, micronutrients should not be applied to fruit crops except when deficiency is shown by leaf analysis, visible symptoms, or on the advice of trained technical persons.

Boron (B)

Boron deficiency occurs mainly on alkaline soils or on sandy knolls. Apples are the most sensitive of the fruit crops to boron deficiency. Symptoms include internal breakdown of the fruit, highly colored fruit that drops prematurely. Soluble boron fertilizers such as 'solubor' should be applied at rates supplying 0.2 kg B/1000 L (1 kg solubor/1000 L) twice starting in early June. At least 2000 L/ha should be sprayed if a proven deficiency of boron exists. Boron excess may result in a yellowing of leaf edges and midrib, reduced yields, and a shortened storage life of the fruit.

Manganese (Mn)

Manganese deficiency occurs occasionally in fruit growing areas of Ontario. Its occurence is closely related to weather conditions particularly rainfall and soil moisture, as well as soil pH. It is most prevalent in wet seasons or with high soil pH (alkaline conditions).

In mild cases of deficiency, there is a yellowing of the interveinal leaf areas of young leaves near the shoot-tip. Normally, this is not serious. Fruit size, yield, and quality appear to be unaffected. If the condition is severe, spray application of manganese sulfate at the rate of 1.3 kg Mn/1000 L (5 kg product) at 2000 L/ha may be used as a corrective measure. Manganese chelates are also effective in correcting manganese deficiency at the rate of 0.25 kg Mn/ha (5 L/ha of 5% product).

TABLE 11. LIME REQUIRED TO CORRECT SOIL ACIDITY BASED ON SOIL pH AND SOIL BUFFER pH FOR ESTABLISHED AND NEW ORCHARDS OR VINEYARDS.

Soil Texture:	**Established orchards or vineyards**		**Before establishment**	
	Coarse — Medium Sands — sandy loams — loams	**Fine Clay loams — clays**	**Coarse — Medium Sands — sandy loams — loams**	**Fine Clay loams — clays**
Lime if pH is below	5.6	5.1	6.1	5.6
Target pH	6.0	5.5	6.5	6.0
Buffer pH	* limestone required — tonnes/ha			
6.9	—	—	2	—
6.8	—	—	2	—
6.7	2	—	2	2
6.6	2	—	3	2
6.5	2	2	3	2
6.4	3	2	4	3
6.3	3	2	5	3
6.2	4	2	6	4
6.1	5	2	7	5
6.0	6	3	9	6
5.9	7	4	10	7
5.8	8	4	12	8
5.7	9	5	13	9
5.6	11	6	15	11
5.5	12	8	17	12
5.4	14	9	19	14
5.3	15	10	20	15
5.2	17	11	20	17
5.1	19	13	20	19
5.0	20	16	20	20
4.9	20	16	20	20
4.8	20	18	20	20
4.7	20	20	20	20
4.6	20	20	20	20

* *ground limestone required based on an agricultural index of 75*

TABLE 12 REDUCTIONS IN FERTILIZER APPLICATION WHERE MANURE IS APPLIED

Class of Livestock	Nitrogen (kg/ha)			Phosphate P_2O_5 (kg/ha)	Potash K_2O (kg/ha)
	F. & W.**	Spr.**	Spr.C**		
Liquid Manure at 10 cubic metres/hectare (One cubic metre = 220 imp. gal; one cubic metre/ha = 90 gal/ac)					
Cattle, Mixed Livestock	5	10	12	4	16
Swine	8	15	19	7	14
Poultry	23	46	58	22	26
Solid manure at 10 tonnes/hectare (66 bu. or 2.40 cubic metres of solid manure = 1 metric tonne approximately. Ten t/ha = 4.5 ton/ac.)					
Cattle, Mixed Livestock	12	24	30	10	44
Swine	15	30	38	20	26
Poultry	70	140	175	75	96

* *These adjustments are based on slightly below average quality manure.*

***F. & W. denotes fall and winter applied manure; Spr. denotes spring applied and not covered immediately, including surface application after seeding; Spr.C. denotes spring applied manure injected or otherwise covered within one day of application.*

Apples

Pruning programs should be considered in deciding nitrogen rates for apples. If pruning is to be severe, nitrogen rates can be cut back or eliminated for a year. On the other hand, light pruning may require higher nitrogen rates to maintain tree vigor and production.

Trees on dwarfing rootstocks generally require more nitrogen per hectare (not per tree) than trees on more vigorous stocks. However, care must be taken with dwarfing rootstocks to avoid too large a crop load and loss of vigor. In fertilizing closely planted trees on dwarfing stocks the percentage of the area is a better guide to fertilizer requirements than tree age. No more than 150 kg N should be applied per hectare. To assess factors that affect fertilizer requirements, leaf analysis offers the best guide.

Tender Fruits

Most peach, tart cherry and plum orchards are grown with cultivation and a cover crop seeded July 1 (Italian rye grass at a rate of 13-17 kg/ha) although they can be successfully grown in sod. Apply 10 kg/ha N, 20 kg/ha P_2O_5 and K_2O before seeding. Pears and sweet cherries are more frequently grown in sod. Fertilizer requirements, particularly nitrogen requirements, will depend on type of soil management as previously outlined.

Peach canker is more serious when nitrogen levels are excessive. Nitrogen rates must be kept moderate in peach orchards for this reason alone. Winter injury is more serious if too much nitrogen is supplied especially with insufficient potassium fertilizer. Cultivation should be stopped early (by early July) in peach orchards to avoid late nitrogen release and more serious winter injury and canker problems.

Fire blight is aggravated by excessive rates of nitrogen in Bartlett pear orchards. However, nitrogen levels should be at a sufficiently high level to produce fruit of adequate size. Balancing nitrogen with adequate potassium may help avoid fire blight.

Grapes

The main limitation of most soils for grapes in the Niagara Peninsula is their fine texture and poor drainage. Most clay loam soils used for grapes need organic matter. Every practical means of increasing the organic-matter level by the use of manure, cover crops, etc., should be followed. Cattle manure is much preferred to lower rates of poultry or hog manure because large amounts of organic matter can be supplied in this way without the risks of excessive nitrogen. (See discussion of Organic Amendments.)

Cover crops such as rye grass should be sown about August 1. Earlier seeding can reduce yields of grapes by increased competition for moisture and nutrients. Apply 10 kg/ha N 20 kg/ha P_2O_5 and K_2O before seeding (13-17 kg/ha).

In some vineyards, while the soils themselves contain large amounts of potassium, not enough is released to the vines. The addition of potash fertilizer is desirable in most vineyards. Applying potash once every second year is more effective than annual application of smaller amounts under these soil conditions. If petiole analysis is not available apply 250 kg/ha K_2O (400 kg/ha muriate of potash) every second year. On the better-drained, coarser textured soils, nitrogen fertilizers give both vine and yield response.

Apply 50 kg/ha nitrogen (150 kg/ha ammonium nitrate) and 120 kg/ha K_2O (200 kg/ha muriate of potash) each spring to grapes grown under sandy loam conditions such as in Southwestern Ontario. The chance of leaching loss is greater with this soil type. Magnesium deficiency is a more likely problem on the sandy loam soils. Foliar application of magnesium is the most effective method of correcting magnesium deficiency of grapes (See Mg). Petiole analysis is the best method of determining these nutrient needs.

Variety plays an important role in potassium requirements of grapes. Varieties such as Veeport, Delaware, Foch, De Chaunac and Dutchess require a higher potassium level than Concord or Niagara.

Small Fruits

Small fruit crops are shallow-rooted and, therefore, require soils well supplied with organic matter and high in fertility. Preparation of the soil before planting is particularly important. For strawberries, heavy manuring (45 t/ha) a year in advance of planting is suggested along with a well-fertilized, weed-smothering, green-manure crop.

If strawberries are to be interplanted between young trees, care must be taken not to stimulate the trees late in the season by late cultivation or too high a rate of nitrogen fertilizer. Long term tree performance should not be sacrificed for the short term inter crop.

When large amounts of straw are worked into the soil when the strawberry planting is to be discarded, extra nitrogen (approx. 60 kgN/ha) should be applied to ensure that the decomposing straw does not cause nitrogen deficiency in the trees.

Soil testing provides a good guide to phosphorus and potassium requirements of small fruits. Table 13 shows the amounts of phosphorus and potassium to apply at various soil test levels.

TABLE 13. PHOSPHORUS AND POTASSIUM REQUIREMENTS FOR HIGH BUSH BLUEBERRIES, STRAWBERRIES, RASPBERRIES, CURRANTS, GOOSEBERRIES AND NURSERY STOCK.

		Phosphorus		**Potassium**		
		Phosphate Required kg P_2O_5/ha				
Soil test (ppm P)	**Rating**	**New Plantings**	**Established Plantings**	**Soil Test (ppm K)**	**Rating**	**Potash Required kg K_2O/ha**
0-3		140	100	11-15		130
4-5		130	90	16-30		120
6-7		120	80	31-45		110
8-9	Low	110	70	46-60	Low	100
10-12		100	70	61-80		90
13-15		90	60	81-100		80
16-20		70	50	101-120		70
21-25		60	40	121-150		60
26-30	Medium	50	30	151-180	Medium	40
31-40		40	20			0
Above 40	High	0	0	Above 180	High	0

High Bush Blueberries

Successful growing of blueberries requires an acid soil with a pH level of 4.3 to 5.0 being optimum for plant growth. Sulfur and/or peat moss should be applied before planting to achieve this pH range.

The amount of fruiting wood is the best guide in determining the amount of nitrogen to apply. There should be enough strong, unbranched shoots each year to replace old canes that are removed by pruning. At pH above 5, use $(NH_4)_2SO_4$ to increase the acidity. If pH is below 5 use urea. Do not use the nitrate form of nitrogen on blueberries. Rates of N to be applied based on age of the plants are shown in Table 14.

A soil test is the most satisfactory method for predicting phosphate and potash requirements. Table 13 shows the amount of phosphorus and potassium to apply at various soil test levels.

If soil test information is not available apply rates of phosphate and potash recommended for low to medium soil tests in Table 13 in April.

Magnesium deficiency is common with blueberry. Soil application of 19 kg/ha Mg (200 kg $MgSO_4$/ha) is effective in controlling this deficiency.

Iron deficiency can be corrected by proper control of soil pH and by application of iron chelate to the foliage and/or soil.

TABLE 14. NITROGEN REQUIREMENT OF HIGH BUSH BLUEBERRIES

Plant Age	**April 1-15 In A Mixed Fertilizer gN/plant**	**May 15 as urea or $(NH_4)_2SO_4$ gN/plant**	**July 1 as urea or $(NH_4)_2SO_4$ gN/plant**
newly set	0	6	6
1 year	3	6	6
2 year	6	6-12	6-12
3 year	9	6-12	6-12
4 year	12	12-18	6-12
5 year	15	12-18	6-12
6 years or older	18	12-18	6-12

WEED CONTROL

Detailed recommendations for the control of weeds in fruit crops are included in Ontario Ministry of Agriculture and Food Publication 75, 1986 Guide to Chemical Weed Control. For information on chemicals, safety precautions, and calibration and care of sprayers refer to Publication 75.

Many horticulture crops can be damaged by certain commonly used herbicides. Sprayers that have been used for hormone-type (2,4-D type) chemicals SHOULD NOT BE USED for applying insecticides or fungicides on horticulture crops.

It is difficult to control quack grass, bindweed, horsetail and other perennials in fruit crops such as strawberries and raspberries which occupy the same area for several years. Perennial weeds should be eradicated or brought under control before fruit crops are planted.

In Publication 75, herbicide recommendations for strawberry plantings are based on a preventative program. The basis of that program is to plant strawberries in land which is free of perennial weeds and then to use herbicides for the first part of the growing season. These herbicides are selected to avoid injury to the strawberry plants while still providing reasonable control of seedling weeds. The remainder of the herbicide program, especially after the first year, depends upon the use of terbacil (Sinbar). Use as low a rate of application as necessary and, in any case, do not exceed the rate given on the label.

Herbicides are used in established orchards to suppress weeds and grass around the fruit trees and thereby reduce the danger of mouse and vole injury to the tree trunks during periods of snow cover. Herbicides can be applied to an area approximately 0.5 m in radius around the base of each tree. Depending upon the equipment used and the spacing of the trees, it may be more suitable to treat a 1 to 1.5 m wide strip along the tree row. On rolling or hilly land where soil erosion could be significant do not treat too wide a strip. While the bark on the trunks of older trees may be somewhat resistant to the effect of herbicides, avoid excessive herbicide contact on the trunks.

In vineyards, herbicides are applied in a strip under the vines. Herbicide applications may be made in both spring and fall but be careful not to exceed the recommended rates for any one year.

When applying herbicides use only enough pressure (approximately 200 kPa) to get uniform distribution of the herbicide. Higher pressures produce smaller droplets which are more subject to drifting and could cause injury to leaves and young vegetative shoots of the fruit crop.

All herbicide rates given in Pub. 75 refer to the area of soil actually treated with the chemical. Read the instructions thoroughly and do your mathematical calculations and measurements carefully.

The weed control program for any fruit planting which will be used for other crops in the near future may require the substitution of other herbicides which do not leave long lasting residues in the soil. Plan at least 2 years ahead.

THINNING OF TREE FRUITS

Apples

Thinning of apples is often required to improve fruit size and to control the alternate bearing habit of some cultivars. Thinning needs must be based on grower experience, taking into account the cultivars involved, the amount of bloom, bee activity, weather conditions during pollination, and previous thinning history of the orchard.

Chemicals available for thinning include nephthaleneacetamide (NAD), naphthaleneacetic acid (NAA) and carbaryl (Sevin).

NAD (naphthaleneacetamide) such as AMIDTHIN: This is a relatively safe material applied at petal fall at concentrations of 50 to 100 ppm depending upon cultivar and growing conditions. It may be concentrated but should be applied during petal fall in at least 1100 to 2200 litres of water per hectare.

NAA (naphthaleneacetic acid) such as NIAGARA-STIK, STAFAST, FRUITONE-N, BARTLETT-STIK: This can be a most effective thinning agent but the amount applied, concentration, cultivars, timing and weather conditions are all important factors affecting the response. NAA must be applied as a dilute spray (See page 00, Table A), usually 7 to 10 days after petal fall.

"Days after petal fall" does not always provide a sufficiently accurate index for timing fruit-thinning sprays. Sensitivity to NAA depends on fruit development which, in turn, depends on environmental conditions. Average fruit diameter reflects these yearly variations in growing conditions. The following fruit sizes resulted in improved thinning of three apple cultivars in Eastern Ontario.

Cultivar	**Diameter at NAA-sensitive Stage**
McIntosh	8.0 - 9.5 mm
Delicious	6.5 - 8.0 mm
Spy	10.0 - 11.0

During a cool spring, fruits may require 12 to 13 days after petal fall to reach the NAA-sensitive stage, whereas during a warm spring, this stage may be reached within six days.

Sampling Method

A total of 50 to 60 fruits of each cultivar should provide a good estimate of fruit development in a reasonably uniform orchard block. Select the **two** largest developing fruits from each of 25 to 30 randomly selected clusters, measure the greatest width of each and determine the sample average. Vernier calipers or fruit-sizing rings provide a simple means for taking measurements rapidly and accurately.

NAA can reduce fruit size without removing any fruit, if not applied at the proper time.

Carbaryl can be applied over a wider time interval following petal fall than either of the above materials. Maximum response is obtained when carbaryl is applied at the most sensitive size outlined above; however, some thinning usually results from later applications up to four weeks after full bloom.

Treatments applied after the most sensitive time do not reduce fruit size. Carbaryl is used at rates of 0.5 to 4 kg active material per hectare, depending upon cultivar and tree size. It can be applied as concentrate spray although higher volumes of water (e.g. 1100-2200 L/ha) are more satisfactory.

Carbaryl plus NAA has been used on hard-to-thin cultivars such as Early McIntosh and Wealthy with considerable success. In general, a constant rate of carbaryl (0.5 kg active ingredient per 1000 litres of water) should be used with varying amounts (3 to 15 ppm) of NAA.

Bee Warning

When Sevin is used in fruit thinning, extensive bee kills can occur if the orchard cover carries a heavy bloom of dandelions or other weed blooms. To avoid such toxicity, keep the dandelions mowed and remove bees from the orchard prior to treatment. Do not spray when the wind will carry Sevin to adjacent weed areas. Advise local beekeepers of your spraying activity. Your local Agricultural Representative has a list of the beekeepers in your area.

Factors Influencing Response to Thinning Agents

1. Cultivar Sensitivity
   (a) Easy-to-thin cultivars include Delicious, Idared, and Spy.
   (b) Hard-to-thin cultivars include Lodi, Duchess, Golden Delicious, Early McIntosh and Wealthy.
2. Certain weather conditions may increase thinning response by permitting greater absorption of chemicals.
   (a) Prolonged period of high humidity prior to spraying.
   (b) Slow drying conditions following treatment.
   (c) Frost or near-freezing temperatures before or shortly after treatment.
   (d) A prolonged period of dry weather before treatment.
3. Pollination and Bee Activity
   These are tied in closely with weather conditions. Pollinating conditions and bee population may render trees either more or less difficult to thin.
4. Tree Age and Vigor
   (a) Young trees are more easily thinned than mature trees.
   (b) Low-vigor mature trees are easily overthinned.
   (c) Trees bearing a heavy crop one year and having good bloom the following year may be more easily thinned; the heavier the bloom, the easier to thin.

5. Pruning
   (a) Poorly-pruned dense trees may be thinned more easily than well-pruned open trees.
   (b) Low, partially-shaded branches of well-pruned trees may be thinned more easily than upper branches.

6. Daminozide (Alar)
   The year following an application of daminozide for controlling fruit drop, there may be excessive fruit set and clustering. Chemical thinners applied at the recommended rates are effective in reducing this problem.

Suggested Rates for Chemical Thinning of Apples

The rates below are suggested guidelines only. There is no substitute for personal experience. It is very important that yearly records be kept on weather conditions, rates, etc., and above all, that some trees be left unsprayed to help assess the thinning response. Use only **one** of the suggested chemical treatments. For example, with Wealthy, apply NAD **or** NAA **or** carbaryl **or** the combination. Do not apply all chemicals.

Cultivar	**NAD[1] ppm**	**NAA[1] ppm**	**Carbaryl[1] kg/1000 L**	**Combination**
Paulared	—	5-10	0.5-1	—
Melba, Transparent, Quinte, Lodi, Empire	50-75	—	0.5-1	—
Early McIntosh, Wealthy, Golden Delicious	75-100	10-20	0.5-1	0.5 kg carbaryl + 3 to 15 ppm NAA in 1000 L
Cortland, Snow, R.I. Greening, Spartan, McIntosh	—	10-20	0.5-1	0.5 kg carbaryl + 3 to 7.5 ppm NAA in 1000 L
Red Delicious, Idared	—	2-8	0.25-0.5	—
Spy	—	5-10	0.25-0.5	—

[1] *Active ingredient, dilute-spray basis*

Calculating Parts per Million (ppm)
1 ppm = 1 g active ingredient per 1000 L water.

Defruiting immature apple trees to encourage proper development is highly desirable. Experimentation to date indicates NAA 15 ppm plus Sevin 1 kg (active) per hectare five days after petal fall as giving best results and NAA 35 ppm plus oil (10 L) as next best on non oil sensitive cultivars.

Peaches

Hand Thinning

Workers using a child's plastic bat or a rubber-hose thinning aid remove much of the excess fruit prior to a follow up hand thinning. Ideally, early cultivars are thinned 15 to 20 cm apart (two to three fruits per shoot). There is little likelihood of overthinning early cultivars when the set is heavy.

Late-maturing cultivars are thinned according to their individual requirements. Heavy-setting, hard-to-size cultivars such as Redhaven require heavier thinning than the easier-to-size types like Golden Jubilee and Loring. As a rule of thumb, however, late maturing cultivars with a good, uniform set are usually thinned 10 to 13 cm apart. Distance between fruits is not too critical as long as clusters are broken up and fruits separated. If the set is spotty on the tree, more fruits may be left on heavy-set branches.

Chemical

There is no truly satisfactory chemical available. Dinitro materials such as Elgetol applied during full bloom may provide satisfactory results in the Niagara Peninsula. Dinitros should not be used in areas and seasons where the risk of late spring frost is high. Dinitro should be applied when 90 to 95% of the blossoms are open. It is preferable to spray a little early rather than after blossoms have been open for some time. Elgetol, for example, may be used at 1.25 to 3.75 L per 1000 L of water, depending on cultivar. Trees under five years of age should not be chemically thinned.

Mechanical

The trunk-shaker method supplemented by hand thinning is now being employed by several growers. The major drawback of this method is that stiff branches are easily overthinned, while willowy or hanging branches are generally underthinned.

It is strongly recommended that an observer accompany the machine operator to help him avoid overthinning. Little is known about short- or long-term damage (if any) caused to feeder roots by mechanical shakers.

Particular care must be exercised in follow-up hand thinning. It may well be necessary to leave more fruit than normal on some of the underthinned branches to compensate for excessive thinning on others.

Plums

The dinitros will thin plums more easily than peaches. Where biennial bearing is occurring, or where size is difficult to attain, bloom-thinning can be helpful. Elgetol at 1.25 L per 1000 L of water is a suggested strength to try.

Pears

Response of pears to chemical thinning agents tends to be inconsistent from year to year. With Bartlett and Anjou, try NAA three to six days after petal fall at 10 to 15 ppm, or NAD at 10 ppm two to three days after full bloom, followed by NAA at 10 ppm three to six days later. For Keiffer and Winter Nelis, NAD at 15 to 20 ppm two to three days after full bloom, followed by NAA at 10 ppm three to six days later, is suggested.

CHEMICAL CONTROL OF PREHARVEST DROP OF APPLES

Cultivars differ in their tendency toward preharvest drop. In this respect, McIntosh gives the greatest concern in Ontario.

Fruit drop tends to be greater with trees in which the nitrogen content is high during the late summer and with trees carrying a heavy crop. Hot days and warm nights just before and during harvest tend to increase the amount of preharvest drop.

Several synthetic hormone substances have been used to control preharvest drop. The best known of these are NAA and daminozide.

1. Daminozide (Alar 85)

Alar has to be applied much earlier in the growing season than the other stop-drop materials. Alar is a growth regulator and can delay fruit maturity. Thorough leaf coverage during spray application is important for satisfactory response by the tree.

With McIntosh, Alar should be applied 60 to 70 days prior to the normal harvest date. Early varieties, such as Melba, can be sprayed closer to harvest (45 days). Rates of application depend upon tree vigor, cultivar and crop load, and should vary from 2.75 to 4.5 kg/ha. High rates on low vigor trees can reduce fruit size.

General Precautions

1. Alar delays maturity. For this reason, spray only a portion of the planting in order to schedule the harvest sequence. Harvest of Alar-treated fruit should be delayed 7 to 10 days until the fruit reaches acceptable maturity. If the harvest is delayed excessively, do not place the fruit in controlled atmosphere storage or in extended cold storage.
2. If high rates of Alar are applied, if trees of low vigor are sprayed, or if Alar application is delayed, a significant increase in fruit set can occur the following season. Growers should be aware of the possibility and be prepared to apply chemical thinners at the normal rate and proper time in order to break up the clusters.
3. Alar should not be applied to the same trees more than one time during the season. It is essential that Alar be used as part of a well-designed orchard management program in which the trees are maintained in a satisfactory state of vigor to prevent adverse effects on fruit size and cropping.

2. NAA (naphthaleneacetic acid) such as Niagara-Stik, Bartlett-Stik, and Fruitone-N.

This is the same material that is used earlier in the season for thinning the crop. The concentrations differ for the two purposes.

NAA is effective for 7 to 12 days after spraying. Longer holding can be obtained by repeated application (of single strength) every 7 days.

Apply NAA before the drop of normal, sound fruit commences, at the rate of 10 ppm. One application of single strength has little effect on direct ripening of the fruit. However, the higher the concentration of NAA used and the greater the number of applications, the greater will be the ripening effect.

PROMOTION OF FLOWERING AND FRUIT SET IN APPLES

The following information is suggested for trial use under the grower's specific conditions.

Non-bearing Apple Trees

Once the tree has developed the desired framework flower and fruit production can be initiated by applying growth regulators. The most satisfactory is Alar which promotes both flower bud formation and increases fruit set the subsequent year. The application made two-three weeks after normal petal fall is most effective. The rate to be applied depends upon cultivar, tree vigor, rootstock and tree density. A rate of 0.5 to 1 kg of Alar-85 per 500 L applied as a dilute spray is suggested.

A combination of 450 g Alar + 330 ml Ethrel tank mixed in 450 litres of water is also effective on most cultivars when applied at 600 L per hectare. Northern Spy or seedling rootstocks should receive double the Alar rate.

Bearing Apple Trees

In order to control vegetative growth, Alar must be applied 2-3 weeks after petal fall. At this time Alar has the maximum effect on reducing fruit size which limits the usefulness of Alar during this part of the season. With a heavy crop Alar alone will not promote return bloom.

Ethrel applied 2-3 weeks after petal fall causes excessive fruit thinning. The maximum thinning with Ethrel occurs during the first four weeks after full bloom.

AS A TRIAL on cultivars such as McIntosh and Northern Spy the application of Alar and Ethrel applied the last week in June (4-5 weeks after petal fall) has been effective in promoting flowering and fruiting of both varieties. The treatment has improved the colour on McIntosh. This treatment is not suggested for any other time of the year because of the side effects. For McIntosh mix 1.5 kg Alar 85 with 500 mL Ethrel in 800 L of water per hectare. On Northern Spy increase the Alar rate to 2.5 kg.

ETHEPHON TO PROMOTE FRUIT COLOURING AND ADVANCING APPLE MATURITY

Ethephon (Ethrel) has the following effects on trees and fruit, depending upon the time and rate of applications:

1. Ethrel stimulates ripening, colour development and fruit drop. The fruit may all be on the ground one week after spraying unless a suitable stop-drop is used. Alar applied at the normal rate in mid-season is not an effective stop-drop to be used with Ethrel. Two applications of naphthaleneacetic acid (NAA) (e.g. Bartlett-Stik or Niagara-Stik) are required: one as a tank mix at the time Ethrel is applied and the second five days later. Apply the stop-drop at the normal rate recommended on the label.
2. **Spray just the number of trees that can be harvested over a two or three day period**. Following the spray application the fruit will have to be harvested within five to ten days. After spraying, check the maturity of the apples on a daily basis (e.g. pressure, starch, flavour, colour). A few trees sprayed at three to four day intervals would be easier to manage than a large number sprayed at one time. **A market should be available for the treated apples before they are sprayed especially with early cultivars.**
3. Rates of application depend upon the cultivar, date of application, tree vigor, temperature, weather conditions and degree of response required. The response to Ethrel is a chemical reaction and as such is dependent upon temperature. For this reason early cultivars such as Red Melba and Early McIntosh require less material than later cultivars. Lower rates do not give as rapid a response but allow picking over a longer time interval

due to a slower ripening. Longer storage life may be possible with lower rates.

On early cultivars such as Red Melba and Early McIntosh, use 0.75 to 1.5 L of Ethrel per hectare applied with sufficient water to wet the trees thoroughly.

McIntosh requires 1.5 to 4.25 L/ha. The higher rate is used early in the season, on trees that are high in nitrogen, or on trees that are poorly pruned. Lower rates may be advantageous nearer the normal harvest, on young, well-pruned trees, or on trees that are low in nitrogen.

4. Experience has shown that a low rate of Ethrel plus NAA applied 5-10 days before harvest as a tank mix following Alar applied as a stop-drop in late July (70 days before harvest) is more satisfactory than Ethrel plus NAA applied alone. Better colour will be developed and the fruit will not mature as rapidly.

PROMALIN TO IMPROVE FRUIT SHAPE OF DELICIOUS

Promalin (Abbott Laboratories, North Chicago, Ill.) has recently been registered for use on Delicious strains in Ontario to improve the appearance of the fruit (elongation and more prominent calyx lobes). Careful timing of the application, close adherence to recommended rates, and complete coverage are essential to satisfactory results.

Application of higher rates or volumes per hectare than those recommended on the label may result in undesirable fruit thinning. Concentrate applications are not recommended at this time. For optimum results the application should be made between the king bloom balloon stage and full bloom. Applications around the king-bloom balloon stage usually produce a greater response. Applications earlier or later than this recommended interval are likely to produce an unsatisfactory response.

Strains of Delicious seem to respond equally to Promalin application. The response will appear to be better on the naturally more-typey strains. Postbloom weather has a strong influence on the development of typiness and will affect the response to Promalin as well. Growers interested in using Promalin should familiarize themselves with the material through carefully applied trial applications to small blocks, leaving some trees untreated for comparison.

SCALD CONTROL OF APPLES

Materials Used

Ethoxyquin and diphenylamine are the two materials used. Ethoxyquin is less liable to cause injury than diphenylamine on varieties such as Golden Delicious, but also may be less effective. These chemicals are available from several sources; formulations from suppliers may differ in concentration of active ingredient and in behaviour.

General Recommended Concentrations

Because formulations may contain different concentrations of active ingredient, the recommended concentrations are given in parts per million (ppm). These can be recalculated on a volume basis using recommendations on the labels of the individual formulations. **READ THE LABEL.**

Ethoxyquin:	All uses — 2700 ppm ai
Diphenylamine:	Preharvest spray — 2000 ppm ai on most varieties, 1000 ppm ai on Golden Delicious and other injury susceptible varieties such as Rome Beauty.
Postharvest:	1000 to 2000 ppm ai.

Application

Preharvest spray: Use ethoxyquin at a rate of 2700 ppm ai. Rome Beauty and Golden Delicious should receive half the dosage cited above (1000 ppm ai) of diphenylamine.

Sprays should be applied within 24 hours of harvest. The trees should be sprayed to the drip stage making sure that the fruit is covered. Materials should be well agitated in the spray tank.

Hand-gun applications may be more effective than air blast. The tank should be flushed before refilling, and the solutions should not be used if over two days old. If harvest is delayed beyond the 24-hour period, or if it rains, the trees should not be resprayed with the same material as this could lead to residues beyond the legal limit. However, ethoxyquin might be used after diphenylamine and vice versa. Do not spray if the temperature is higher than 27°C.

Because of difficulties in getting through the orchard with a spray rig at harvest-time, the need of picking within 24 hours of application, the higher cost of preharvest sprays and the uncertainties of weather, postharvest treatment is preferred to the preharvest spray.

Postharvest treatment Use ethoxyquin at 2700 ppm ai. With diphenylamine, 1000 ppm ai is usually sufficient and there is considerably less chance of injury than when using 2000 ppm ai which may give better control of scald. On Cortland, because of its extreme susceptibility to scald, use 2000 ppm. If there is a history of scald development in a particular strain, or fruit from a particular orchard, 1500 to 2000 ppm diphenylamine may give better control but see "Precautions" below.

Methods of application include (a) dipping the boxes or bins of fruit into a tank containing the solution; (b) spraying or dipping the loose fruit, and, (c) using an overhead drench type of applicator. The overhead drenchers may be for individual bins or for truckloads of fruit. Irrespective of type of treatment, good coverage of each apple is important for control of scald, and good drainage is important to minimize injury. For best results, apply immediately after harvest, although there may be some effect for up to two weeks after harvest. The fruit temperature should be between 16 and 27°C. If the temperature is too low, effectiveness is lost; if too high, there may be injury. For similar reasons the temperature of the material should be between 10 and 32°C.

The material in the tank should be kept well agitated. Fresh material should be prepared after treatment of 2000 bushels (100 bins) per 100 gallons and when it becomes too dirty. The system should be fitted with a filter so that dirt which might cause surface discoloration of the apples is not recirculated. All fruits should be covered thoroughly, and provision should be made for draining off the excess material. With ethoxyquin, because liquid is removed during treatment, premixed dilute solution should be kept on hand for topping up the treatment tank or reservoir; topping up with water will weaken the solution and make it less effective. Because diphenylamine is in suspension and the active ingredient may be removed on the fruit without the corresponding amount of water, the strength of the suspension may decrease with time, and even adding premixed material may not restore the original concentration. There is no easy way to check the strength of the suspension. However, changing the material after treatment of 100 bins per 100 gallons of solution and adding premixed material as makeup solution should ensure that the suspension does not become diluted and ineffective. Test kits are now available to check the strength of the suspension but they are costly.

Precautions

When using for the first time a postharvest application, a trial on only a limited volume of fruit is recommended. Because of possible injury ethoxyquin is the preferred material on Rome Beauty and Golden Delicious. There have been some reports that ethoxyquin may reduce the yellowing of Golden Delicious coincident with normal ripening. Diphenylamine is the approved material on Idared because there have been reports of a bitter flavor when ethoxyquin was used on this variety. This effect has been attributed to using year-old material. Obviously the use of new material is advisable. Some people may be sensitive to the two materials, and this may necessitate wearing gloves.

Postharvest applications are more positive and less expensive than field applications, but may cause more injury. In a really bad scald year no treatment may be 100% effective. Although scald may develop in storage, further scald development occurs when the fruit is held at a high temperature during the poststorage marketing period. Fruit samples should be removed from storage at monthly intervals and held at room temperature to check on the occurrence of scald. This is particularly true of apples held in CA storage. Some other disorders may confuse identification of common scald. Jonathan Spot on Idared, skin discoloration resulting from internal breakdown, and external low-O_2 injury may be confused with common storage scald.

The directions on the labels of the chemical containers should be read and understood before beginning treatment. Residue tolerances have been set by the Food and Drug Directorate, and misapplications may result in residues above legal tolerances.

In other countries, tolerances may vary. Thus, persons planning export should check with the Canadian Horticultural Council in Ottawa. Pomace from apples treated with diphenylamine should not be fed to animals as this may lead to residues above the zero tolerances for meat and milk. There is no legal requirement in Ontario for labeling apples treated after harvest. However, in New York and Michigan such labeling is required for apples treated with ethoxyquin and diphenylamine after harvest.

CA STORAGE RECOMMENDATIONS FOR APPLES

General Considerations

1. Cultivars (varieties) should be stored together only if recommended temperatures, atmospheres and harvest-times correspond. Benefit of CA or any other kind of storage is realized only when apples are mature but not ripe, when put in storage. Maturity of some cultivars can be determined with starch-iodine solution. Refer to Factsheet 211/59 *Evaluating Apple Maturity Using the Starch-Iodine Test*. For other methods of selecting proper harvest date refer to Ministry of Agriculture and Food Publication 431, *Harvesting, Storing and Packing Apples*, pages 3 to 8.

   Holding one cultivar of apple in cold storage until the room can be filled with a cultivar harvested later is not a good practice. In New York there is a limit on the filling time of CA rooms, but not in Ontario.

2. The 2.0 to 2.5% limit on CO_2 level used for McIntosh in the first month (see Table 15) is important in lowering the susceptibility of the fruit to CO_2 injury. In some years and in some areas this may not be necessary, but is a precaution that should not be ignored as just another inconvenience. The temperature should not go below 2°C (36°F) for McIntosh, or there can be a high incidence of brown core and stem-cavity browning.
3. Injuries may be caused by low O_2 levels and high CO_2 levels. The O_2 level should not be below 2.5% (See Low-O_2 storage.) and the CO_2 level not more than 0.5% above the recommended level. Low CO_2 levels will not harm the fruit directly, but the recommended level of 4.5%-5.0% is important, especially in reducing the rate of softening of McIntosh. Those operators using supplemental scrubbing with lime directly in the room should not use much more than the recommended amounts or the CO_2 level may not rise to 4.5% - 5.0% as quickly as desirable.
4. McIntosh apples held in 2.0% O_2 plus 4.5% CO_2 may be slightly firmer after storage than those held at 2.5 to 3.0% O_2 plus 4.5% CO_2. However with the 4.5% CO_2 level necessary there can be low-O_2 injury to the fruit. As well at a temperature lower than 3°C low O_2 injury is more likely to occur at 2% O_2 than the normal 2.5-3% O_2. Overall the likelihood for injury with a potential for only slight additional firmness does not permit recommendation of 2.0% O_2.
5. The atmospheres recommended have generally been selected after a great deal of experimental work and accumulation of practical knowledge. Although some variation from the recommended conditions must be expected, and in some years considerable variations may do little harm, it is wise to maintain the atmospheres close to those recommended. The amount of variation will depend on the mechanical suitability of the rooms and the equipment, and the experience and skill of the operator.
6. The freezing point of apples is in the −2.0 to −1.5°C range. Storage at −0.5°C may give some extra storage life but is also risky. Distance temperature sensing devices should be used to measure temperature in areas remote from the access door at which thermometers may be visible through a clear plexiglass panel. There may be areas in the room in which the temperature may be considerably different than at the front because of poor air circulation and/or inadequate insulation. Thermometers should be calibrated before use with a stirred water ice-water mixture which should give a temperature of 0°C (32°F).

TABLE 15. RECOMMENDED CA CONDITIONS FOR APPLES IN ONTARIO

Cultivar	Temperature		Relative humidity	Atmosphere %	
	°F	°C	%	O_2	CO_2
McIntosh	37-38	3	95	2.5-3.0	2.0-2.5 The first month then 4.5-5.0
Cortland (see note over page)					
All other cultivars	32	0	95	2.5-3.0	2.5-3.0

Notes on Some Cultivars

Cortland Research in New York has shown that Cortland may be held at either recommendation in Table 15. Choice of conditions may depend on harvest date and space available.

Idared Idared stores well in cold storage at 0°C (32°F). However, there may be some advantage to CA for long-term storage. Jonathan Spot on Idared is controlled in CA. Some years ago there was some concern that CO_2 in the atmosphere caused a browning of the core in Idared. Our recent research has indicated that this disorder could occur, but only at a CO_2 level of 5% or more. Therefore holding the CO_2 level at 2.5% or lower may be a good safety measure.

Empire and Spartan We have had experience for six years with these two cultivars in small-scale trials. This experience and results from other places indicate that they store well at 0°C (32°F) and the atmosphere recommended for "all other cultivars" in Table 15.

For further details on CA storage, refer to the newly revised Ontario Ministry of Agriculture and Food Publication 431, *Harvesting, Storing and Packing Apples*.

LOW-O_2 STORAGE

Research is ongoing with what is now called low-O_2 or ultra-low-O_2 storage. Research and commercial trials in Ontario have shown the potential benefit of this treatment on McIntosh. There can be benefit with other cultivars but usually the effect is considerably less. The simplest O_2-CO_2 combination appears to be 1% O_2 plus less than 1% CO_2 with the latter scrubbed by lime placed inside the room. The temperature used has been the normal one for McIntosh in CA, that is, 3.0°C. There is some evidence that early harvested McIntosh are less likely to be injured than later harvested fruit and that diphenylamine-treated fruit are more susceptible to low-O_2 injury than those untreated. Possibly some of this effect may be due to the diphenylamine clogging the pores of the fruit but more likely to the surface water retarding gas exchange. Chemical scald control is less critical in apples stored in low-O_2 because the atmosphere tends to reduce the incidence of scald.

In England where this low-O_2 recommendation originated for Cox's Orange Pippin, researchers regard low-O_2 storage as too risky for commercial operation without constant monitoring and correction of atmospheres with electronic instrumentation including analyses for alcohol as an indication of incipient low-O_2 injury. However the storage operators in Ontario using this technique have made most analyses with the Orsat analyzer. Considering that the variability of measurement with an Orsat is at very best ± 0.1% and that there may be sampling error, holding a room at 1% O_2 is hazardous. Because of the variability in analyses and in actual atmosphere concentration, it is also possible to get low-O_2, injury without improving the firmness of the fruit. Operators attempting low-O_2 storage should ensure that they can sample fruit from the room frequently. These fruits should be checked for visible symptoms externally and internally for low-O_2 injury, and also tasted for off-flavors, both one day after removal from storage and after a week in air at 20°C. In the absence of equipment for alcohol analysis this may be the best that can be done. Alcohol analyses of the storage atmosphere are usually not sufficiently sensitive to detect the first indications of harmful levels *within* the fruit. However analyses with gas chromatography can be used to detect alcohol production of fruit removed from storage. If there is a high incidence of symptoms of injury the atmosphere of the room should be changed to air. Apples with slight injury may recover upon removal to air.

Overall the possibilities for injury by low-oxygen conditions and the unknown variables influencing injury do not permit a general recommendation for Ontario.

LOW-ETHYLENE STORAGE

Research has indicated the benefit of removing ethylene almost completely from rooms held at normal CA conditions (Table 15). Used properly there is no chance of fruit injury. However fruit must be chosen carefully to minimize ethylene production, rooms must be filled quickly, nitrogen must be used for the quick oxygen pulldown because a catalytic generator adds ethylene to the room atmosphere, and the ethylene scrubbing system is an extra cost. With the utmost care in selection of fruit and storage operational procedures ethylene scrubbing may be effective as long as the ethylene level never exceeds 1 part per million.

POSTHARVEST DIPS FOR STORAGE ROTS

Storage rots occur from infections of the fruit through wounds. Proper sanitation of the storage and handling equipment is necessary to help reduce infections. Infection of wounds in the dip tank is a common occurrence. The addition of a fungicide to the dip tank will help prevent these infections. Subsequent infection in the storage will also be prevented by this treatment. Fruit already infected will not benefit from this treatment.

Fungicide	**Amt per 1000 L**
*benomyl 50% WP or	500 g
**thiabendazole 42% F	1 L

* *Benomyl and thiabendazole will not control alternaria rot.*
***Do not use with Stop-Scald.*

MOUSE AND VOLE CONTROL IN ORCHARDS

Mice in orchards are most effectively controlled by a season long mouse management approach. They are in the orchard because they can readily obtain the three basics for their survival — food, shelter and minimum predator exposure. By denying mice these three basics, season-long populations will not flourish.

A wide herbicide strip in the tree row or under individual trees coupled with regular close mowing of orchard cover helps to discourage mice. The abundance of nesting material and places to hide offered by brush and trash should be avoided. Remove straw, trash, sod, etc. from around the base of the tree for at least 60 cm from the trunk. Predation by the domestic cat, foxes and birds of prey all contribute to a low mouse population.

At harvest time check for signs of mice in the orchard — fresh grass clippings in runways, tunnels, droppings and chewed apples. Baits are most effective if dropped apples are picked up and removed from the orchard. Before the grass falls over and the ground is covered with snow, broadcast a bait over the floor of the orchard. Baits are best applied on bright days with no rain expected for several days.

Baits available:

1. Waxed-Zinc-Phosphide-treated baits: 5.5 to 11 kg/hectare, depending on the severity of infestation. If further mouse activity is detected, repeat the treatment when rain is not expected.

2. Diphacinone (Ramik Brown) — 22 kg/hectare in two applications of 11 kg each. Applications can be made 20 to 40 days apart.
3. Chlorophacinone (Rozol, K$_5$C^5) — 11 kg/hectare. Repeat in 20 to 60 days where infestation is high.

Bait Stations

The use of bait stations provides a means of achieving a longer period of control of voles than broadcast treatment. Various materials such as slab wood, pieces of board, or tin cans with one end removed can be used for bait stations. The bait is placed under the board, or in the can, with the can lying on its side. The "inverted T" bait station made of 1-1/2 inch ABS pipe is perhaps the most effective type of bait station available. In this station several tablespoons of bait are placed in the neck which is capped, thus, protecting the bait from the elements. Bait stations should be used at a rate of approximately 25 per hectare (10 per acre).

CAUTIONS IN HANDLING POISON BAITS **These baits are poisonous to human beings, domestic animals and wildlife.**

Store the bait in a shed away from children, irresponsible persons and animals. Wear rubber or neoprene gloves for hazardous compounds and wash after handling poison baits. Avoid inhalation of dust or fumes. Destroy empty containers by burning or by burying in non-cropland away from water. Keep children, pets, and domestic animals away from treated areas. Where possible remove mouse bodies and bury or dispose of them in the garbage.

Tree Guards for Mice

For maximum tree protection all newly planted trees should have a guard placed around the trunk. The bottom of the guard should be buried in the soil 5 cm deep, or better yet, in a mound of fine crushed stone or sharp cinders. All tree guards should be checked each fall to see that they are mouse tight, free of trash and are not interfering with root development.

A number of commercial tree guards are available. Two of the most common are spiral plastic and galvanized wire mesh. Grower experience has shown that a guard approximately 45 cm high is adequate. If you are making your own guards do not use dark coloured materials or tar paper. These materials can increase the temperature of the bark on sunny days and subsequent lower temperatures can cause injury to the bark tissue. Heavy aluminum foil or thin metal sheets should be avoided. Unventilated guards of this type have the potential to damage trees by allowing the trunk to heat. Spiral tree guards should be checked and adjusted annually to prevent the guard from interfering with trunk expansion (growth).

RABBIT CONTROL

Rabbit Repellents

Rabbit repellents containing thiram, when properly used, appear to offer reasonable tree protection. There are a number of commercial preparations available some of which mix white latex paint with the thiram. Before using these commercial preparations, or any other materials, consult the label and avoid undue dilution of the product. Be sure to treat the tree as high as rabbits can reach when standing on deep snow. The repellents may be applied with a small knapsack sprayer or painted on with a brush. Most growers apply this paint on small trees by putting a wool sock or car wash mit over a pesticide safe glove and smearing the paint on the tree. Most commercial preparations will not hurt buds. The white latex paint is a good carrier for thiram and also serves to protect the trees against Southwest Injury (See Page 00).

Shoot the Rabbits

Shooting rabbits is an excellent means of keeping the population down. However, it must be done regularly throughout the year because other rabbits soon move into the orchard area. Shooting alone cannot be depended upon to provide adequate control.

Wrapping Young Trees

Wrap sacking about the top and the trunk bove the mouse guard to protect young trees from rabbits. Tie the wrapped tree securely to a strong stake or steel fence post to prevent snow and ice breaking the tree over. Mouse guards generally do not give protection against rabbits when the snow is deep.

Repairing Damage by Mice and Rabbits

Regular inspection should be carried out throughout the winter to see if any injury has occurred. Mice often work just below the surface of the snow or in the litter. If a tree has been wholly or partially girdled, it should be given first aid immediately. Cover the wound with a grafting compound or a wound dressing.

Before the buds swell in the spring, secure enough long scions to bridge the wound. See OMAF Factsheet, Repair Grafting, AGDEX 210/24. Store the scions in damp sand or sawdust in a cool place. If the wound extends for more than one quarter of the circumference of the trunk, bridge graft in the manner described in Factsheet, Repair Grafting. Grafting should be done when the bark slips readily from the wood (about bloom). Repair grafting is not feasible on trees with a diameter less than 10 cm. Small trees should be replaced.

CONTROL OF GROUNDHOGS IN ORCHARDS

Winter is a poor time for control as the woodchuck is hibernating in a sealed-off chamber in its burrow.

1. **Phostoxin** (fumigant) This product is manufactured in tablet form. Packages contain three tubes with 30 tablets per tube, or a total of 90 tablets. Rate of application is one tablet per hole. All entrances must be sealed to prevent gas from escaping.

   Phostoxin contains aluminum phosphide. In the presence of moisture, phosphide gas (phosphine) is released, which is claimed to be effective against groundhogs. The distributor of this material, Abell Waco Ltd., requires the user to take instruction on using this product before it can be purchased. (A Factsheet, Aluminum Phosphide for Groundhog Control, is available from the Ontario Ministry of the Environment.)
2. **Gas Cartridges** These are cardboard cylinders containing a mixture that burns slowly and asphyxiates the groundhog. The cartridge is placed in the burrow of the groundhog and all entrances must be sealed. Follow manufacturer's instructions on the preparation and use of cartridges.
3. **Trapping** This method can be effective for groundhog control; however, it is time-consuming. No. 2 steel traps (muskrat traps) are most practical. Traps should be checked at least twice a day and should be cleaned after each catch.

4. **Shooting** This method can be an excellent means of keeping groundhogs under control. However, it must be done regularly from spring to fall.

BIRD DAMAGE AND ITS PREVENTION IN ORCHARDS AND VINEYARDS

Every year, birds destroy large quantities of fruit in Ontario. Cherries, grapes and blueberries are crops most subject to attack, but other fruit crops may also be damaged. Losses of 25% for sweet cherry and 10% for grape crops are not uncommon, although the extent of fruit damage varies greatly among varieties, location and seasons. Pecking and puncturing damage is usually greater than actual losses from fruit consumed.

Several bird species are responsible for damage to ripening fruit crops. Among the most destructive are robins, starlings, grackles and orioles. A report published by the Canadian Wildlife Service identified adult robins and grackles as the main culprits damaging early ripening sweet cherries; starlings and, to a less extent, juvenile robins cause most of the damage to later ripening cherries. Grapes are taken mainly by robins, but flocks of starlings do cause periodic damage. Migrating Baltimore orioles reportedly limit their attack mainly to early ripening table grapes during late August.

Birds show definite preference among fruit varieties. The Wildlife Service Report implicated fruit color differences as the explanation for this varietal preference. Robins, grackles and starlings commonly select the reddest cherries or darkest grapes available. Early ripening black sweet cherries and French hybrid grapes are, therefore, particularly susceptible to bird damage. Small-berried, early ripening, blue varieties of grapes such as Leon Millot and Marechal Foch are often stripped rather than pecked.

Methods of Control

Discussion herein of certain drastic control measures does not imply their universal recommendation. In all cases, local, provincial and federal laws governing killing of birds, or the use of sound-scaring devices, must be followed.

Location The location in which commercial fruit crops are planted can be an important factor in the control of birds. Cherry orchards planted near a wooded area are particularly susceptible to damage as birds find shelter and nesting sites close by. Similarly, small fruit plantings near hedges are particularly vulnerable.

Physical Protection The only completely foolproof method of control is to cover plants with netting thereby physically preventing birds from getting at the fruit. This method may be economically feasible for some grapes and highbush blueberries but would seem impractical for tree fruits.

Shooting Shooting starlings and grackles is still a very practical control method. Normally shooting does not materially reduce the bird population, but serves primarily as a technique to frighten them out of the orchard. Robins and Baltimore orioles are protected by an act of parliament, but special permits may be obtained to kill them when they are shown to be causing damage. Shells are also available with delayed explosions and/or sustained whistles which disorient and frighten the birds.

Automatic Exploders One of the most commonly used bird controls is the automatic exploder. This is an acetylene- or butane-powered, cannon-like machine set to produce loud gunshot sounds at intervals. Robins soon become accustomed to these and are sometimes observed perched fearlessly nearby the devices while they explode. Automatic exploders are particularly effective when used in conjunction with shooting.

Av-Alarm The Av-Alarm is the latest and most effective device available. It sends out an electronic sound which apparently deafens birds temporarily, causing them to move out of an orchard after one or two days of exposure. The Av-Alarm has been widely used in Ontario and has effectively prevented bird damage to sweet and sour cherries, grapes and other fruit crops.

Chemical Controls At the time of writing, THERE ARE NO CHEMICALS REGISTERED FOR USE IN ONTARIO FOR THE CONTROL OF BIRDS IN FRUIT CROPS. It is illegal to use unregistered chemicals on any food crops.

Other Methods Other control methods tried include broadcast distress and alarm calls, aluminum foil hung in trees, model hawks, strips of yellow plastic hung across vineyards, scarecrows with power-driven moving arms, trapping, and various noisemakers. These have met with only limited success.

CONTROL OF SOUTHWEST INJURY ON FRUIT TREES

Southwest injury (winter sunscald) occurs during the winter and is especially severe when cold sunny days are followed by cold clear nights. Injuries are usually confined to the south and southwest sides of the trunks and main scaffold branches. On sunny days these tissues become considerably warmer than the surrounding air and at night they cool rapidly; freezing of the bark may occur. Freezing injury usually affects large portions of the bark tissue which becomes brown and will eventually slough off as healing occurs beneath. In stone fruit orchards, these injuries provide ideal sites for infection by the peach canker or other canker diseases. The combined effect of southwest injury and peach canker greatly reduces the productive life of affected trees.

Southwest injury can be prevented and peach canker reduced by painting the trunk, crotches, and lower parts of main scaffold branches with exterior white latex paint. OIL-BASED PAINTS SHOULD NOT BE USED. They contain toxic materials which may injure or kill fruit trees. Latex paints which contain some oil should not be used either. The white paint reflects sunlight and prevents the tissues exposed to direct sunshine from rapid thawing on cold days when air temperatures are below freezing. Rapid thawing in the day and freezing at night are prevented by the paint and thereby reduce freezing injury.

October is the best time to apply the paint. Best results are obtained when trees are painted on days when the temperature is above 10°C and conditions favor rapid drying. The paint may be applied by brush or by spray. On young trees, the whole trunk should be painted; but on older trees only the south and southwest sides of the tree require painting. The whiter the bark after painting, the greater the protection.

On young trees, one to three years old, injury from rodents may be a greater problem than southwest injury. To obtain protection from both problems, thiram (75% white WP) should be incorporated into the paint*. Thiram acts as a taste repellent for rodents and helps to prevent infection by peach canker. Mix 400 g of thiram with 2 litres of water and stir slowly into 4 litres of paint. This mixture may also be used effectively as a wound dressing. On older trees where rodent damage is less of a problem, the thiram can be left out and the diluted paint used by itself. One or two quarts of

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****A number of commercial pre-mixtures are also available.***

water per gallon of paint may be necessary if the material is applied by spray, depending on the thickness of the paint and the air pressure available.

Note that the thiram-latex mixture should not be used if a fall bordeaux spray program is planned. The thiram reacts with the bordeaux spray, changing the color of the paint from white to brown, and reducing its effectiveness as a heat reflectant. The bordeaux spray does not affect trees painted with latex only and can be used when thiram is excluded from the mixture. If the thiram-latex mixture is planned as a combined rodent repellent and protectant from southwest injury, then the whole trunk must be painted and good coverage at the soil line is very important to prevent mouse damage.

NEMATODES

Root-lesion nematodes can be a major cause of orchard replant failures. They can also cause a decline in vigor of existing peach and cherry orchards. These nematodes kill the fine feeder roots and cause small brown lesions on the white lateral roots. These lesions can merge and discolor the entire root system. Severely affected trees may not have any feeder roots and if the tree is a replant it usually dies. The most striking aboveground indication of nematode damage in an orchard is a general lack of uniformity of trees.

Root-lesion nematode damage on strawberries usually consists of a discoloration of the fine feeder roots and tiny, brown, scratch-like lesions on the young adventitious roots. These lesions merge to form large brown areas on the roots. There is also evidence that root-lesion nematodes are involved in the black root-rot complex and that they aggravate verticillium wilt of strawberries.

Preplant soil fumigation is the most effective method of controlling nematode problems and is practical when planting a new orchard or when replanting an orchard on an old tree site. Custom operators can do either broadcast fumigation or tree-row. Tree-row application (treating a 2.0-2.5 metre strip centered on the row) is more economical. However, broadcast fumigation is necessary if a grower is going to interplant with a crop such as potato or strawberry.

Areas that harbor potential nematode problems should be treated before planting. For details concerning nematode problems and preplant soil fumigation, consult your Horticultural Crop Advisor. OMAF Factsheets available are: *Root-Lesion Nematode in Ontario Orchards, Agdex 210/628; Soil and Root Sampling for Nematode Analysis, Agdex 628; Nematode Control Guidelines for the Appplication of Soil Fumigants, Agdex 628 and Soil Fumigants, Agdex 606.*

Nematode and other problems in orchard, and strawberry and raspberry plantings can be controlled with the following chemicals:

TABLE 16. CONTROL OF NEMATODES AND OTHER PROBLEMS IN MINERAL SOIL IN ORCHARDS AND IN STRAWBERRY AND RASPBERRY PLANTINGS

Material	Broadcast (L/ha)	Control
(I) ORCHARDS — Use higher rate for heavier soils		
Telone IIB	200	nematodes
Vapam*	550-900	nematodes, weeds, diseases
Vorlex Plus	55-130	nematodes
Vorlex Plus	225-450	nematodes, weeds, diseases
(II) STRAWBERRY & RASPBERRY — For Elite and Foundation Strawberry plant stock use rate for disease control.		
Telone IIB	170	nematodes
Vapam*	550-900	nematodes, weeds, diseases
Vorlex Plus	55-130	nematodes
Vorlex Plus	225-450	nematodes, weeds, diseases

**Vapam is applied by shank injection or in irrigation water ("chemigation").*
See below for tree site instructions.

Always follow manufacturer's directions carefully concerning dosage and methods of use. Preplant fumigation is most effective when:

1. It is done in the fall when soil temperatures are above 4°C.
2. Trash and old root systems are removed; the soil worked to a depth of 25 to 30 cm and in good seedbed condition with regard to tilth and moisture.
3. The fumigant is injected about 20 cm deep.
4. The soil surface is sealed by packing or watering immediately after injection of the fumigant.
5. The soil is left undisturbed until spring or, in the case of fall planting, at least one week after injection of the fumigant.
6. The soil is worked and aerated for about a week before planting. For fall planting the soil should be aerated at least two weeks after working.
7. Good nursery stock grown preferably in fumigated soil.
8. Italian Rye Grass is used as an annual cover crop in cultivated orchards; Kentucky Tall Fescue or Creeping Red Fescue is used as a permanent sod. These three grasses are poor hosts of the root-lesion nematode.

SINGLE TREE SITES FOR REPLACEMENT TREES

The procedure for preplant fumigation of single tree sites is the same as that described above, except that the fumigant is injected with a hand applicator (Fumigun) on 20 × 20 cm centers over a 2.5 × 2.5 m area. Rates per injection point are: Telone 0.8 mL; Vorlex Plus 0.2-0.5 mL (nematodes); Vorlex Plus 0.8-1.7 mL (nematodes, weeds, diseases). Fumiguns usually can be rented from custom applicators or pesticide dealers.

Vapam, for tree site application, may be mixed with the water and applied as a drench **in the fall** after the site has been prepared. Construct a circular basin, 2 metres across, on each tree site. Add 0.3 litres Vapam to 90 litres water in a drum or tank, agitate, and apply to each basin. This volume is necessary for adequate penetration in the proposed root zone.

Postplant Treatment (Non-Bearing Apples)

Postplant treatment of non-bearing apple trees for reduction of root-lesion nematode numbers can be achieved with oxamyl (Vydate L = 240 g active oxamyl/L). Apply a liquid soil drench soon after planting. The liquid soil drench is mixed at 1.25 litres Vydate/100 L water and applied at 3.5-10 L of solution per tree, in a circle around the base of the tree to cover the root zone. **Do not use if temperature is below 7°C** as Vydate is less effective at low temperatures. When leaves have expanded, apply a foliar application and repeat in 3-4 weeks. (Do not allow spray to drift on any trees in bloom). The foliar spray mix is 4.1-8.2 litres Vydate/1000 L water applied at not over 9.3 litres Vydate/ha in any one application. Soil sampling for nematodes in early September of the planting year is advisable to check on the need for further treatment.

For established non-bearing apple trees, apply the liquid soil drench early in April when buds are swelling. Apply a foliar spray before tight cluster and after petal fall. **DO NOT APPLY DURING THE PINK OR BLOOM PERIOD AS VYDATE IS HIGHLY TOXIC TO BEES.**

Root absorption of Vydate occurs during periods of rapid root growth (early spring). Foliar absorption occurs best in young, rapidly expanding foliage. See the manufacturer's label for further details, precautions and methods of application.

No soil-borne disease control should be expected with Vydate L. Postplant treatments for nematode control are considered less effective than preplant soil fumigation. Postbloom foliar sprays will interfere with insect predators and are not recommended in orchards on IPM.

TABLE 17 CROPS FOR WHICH A CROP INSURANCE PLAN IS AVAILABLE IN ONTARIO INCLUDE:

Vegetables

- Asparagus
- * Beans (green and wax, processing only)
- Beets
- Broccoli
- Cabbage
- Carrots
- Cauliflower
- Celery
- Cucumbers
- Lettuce
- * Lima beans (processing only)
- Parsnips
- * Peas (processing only)
- Peppers
- Potatoes
- Pumpkins
- Rutabagas
- Seed Onions
- Set Onions
- Spanish Onions
- Squash
- Sweet corn (fresh)
- * Sweet corn (processing)
- Tomatoes
- * Tomatoes (processing)

Fruit Crops

- Apples
- Grapes
- Peaches
- Pears
- Plums
- Sour cherries
- Strawberries
- Sweet cherries

General Crops

- Canola
- Corn (grain and silage)
- Hay
- New Forage seeding
- Sweet Corn
- Spring grain
- Soybeans
- White beans
- Colored beans
- Winter Wheat

Tobacco

- Flue-cured
- Burley
- Black

* *Insurance contracts are available through processing companies only.*

Insurance contracts for all other crops are available from Crop Insurance agents only.

For further information, contact your local Crop Insurance agent or:

The Crop Insurance Commission of Ontario
Ontario Ministry of Agriculture and Food
Legislative Buildings, Queen's Park
Toronto, Ontario M7A 1B7
Telephone 416-965-1811

CROP INSURANCE

The Government of Ontario, in co-operation with the Government of Canada, has developed a comprehensive scheme of crop insurance protection. The Canada-Ontario Crop Insurance Program is administered by the Crop Insurance Commission of Ontario. The Government of Canada provides financial assistance to this program by contributing 50% of the total required premium each year. In 1985, the contribution by the Federal Government amounted to $21 million.

The Government of Ontario contributed $3.8 million for administering the program in 1985. As a result, this valuable protection is available to Ontario growers at less than half the total cost. The premium is also an operating expense for income tax purposes.

Crop insurance offers protection against loss from a broad range of production hazards, including excessive rain, excessive drought, winter damage, frost, hail, wind, certain pests and diseases, etc.

TABLE 18. PESTICIDES USED TO PROTECT FRUIT CROPS

a – acaricide, miticide
b – bactericide
i – insecticide
f – fungicide
n – nematicide
h – herbicide
r – rodenticide

Brand or Trade Name	( ) ( )		Common or Chemical Name
Agri-Mycin 17	3	b	streptomycin sulfate
Ambush, Pounce	3	i	permethrin
APM, Guthion	5	i	azinphos-methyl
Basudin, Diazinon	2	i	diazinon
Belmark	2	i	fenvalerate
Benlate	3	f	benomyl
Botran	3	f	dichloran
Captan, Orthocide	2	f	captan
Carzol	5	a	formetanate hydrochloride
Chlordane	2	i	chlordane
Cygon	2	i	dimethoate
Cyprex, Equal	3	f	dodine
Decis	5	i	deltamethrin
Diazinon, Basudin	2	i	diazinon
Dichlone, Phygon-XL	3	f	dichlone
Difolatan	2	f	captafol
Dikar	3	af	no common name
Dithane M-22, Manzate D, Mantox	3	f	maneb
Dithane M-45, Manzate 200	3	f	mancozeb
Dithane Z78	3	f	zineb
Dyrene	3	f	anilazine
Elgetol	3	f	DNOC
Equal, Cyprex	3	f	dodine
Ferbam	3	f	ferbam
Funginex	6	f	triforine
Guthion, APM	5	i	azinphos methyl
Imidan	3	i	phosmet
Karathane	2	af	dinocap
Kelthane	2	a	dicofol
Lannate	2	i	methomyl
Malathion	3	i	malathion
Mantox, Manzate D Dithane M22	3	f	maneb
Manzate 200, Dithane M45	3	f	mancozeb
Marlate 200	3	i	methoxychlor
Morestan	3	af	chinomethionat
Omite	3	a	propargite
Orthocide, Captan	2	f	captan
Parathion	5	i	parathion
Phaltan	3	f	folpet
Phosdrin	5	i	mevinphos
Phygon-XL, Dichlone	3	f	dichlone
Pirimor	2	i	pirimicarb
Plictran	3	a	cyhexatin
Polyram	3	f	metiram
Pounce, Ambush	3	i	permethrin
Ramik Brown	6	r	diphacinone
Ridomil	3	f	metalaxyl
Ripcord	2	i	cypermethrin
Rotenone	3	i	rotenone
Rovral	3	f	iprodione
Sevin	3	i	carbaryl
Supracide	5	i	methidathion
Systox	5	i	demeton
Telone IIB	2	n	1, 3 dichloropropene
Thiodan	2	i	endosulfan
Vapam	3	bifnh	metam sodium
Vorlex Plus CP	2	bifnh	1,3 dichloropropene + chloropicrin + methyl isothiocyanate
Vorlex Plus	2	bifnh	1,3 dichloropropene + methyl isothiocyanate
Vydate	5	in	oxamyl
Zolone	2	i	phosalone

The numbers in this column ( ) identify the Schedules in which the BRAND NAME products listed in this Table are classified under the Pesticides Act.

Explanation of Schedules

Schedule 1 Restricted. Use permit only.
Schedule 2 Restricted to agriculturalists, licensed exterminators and registered custom sprayers.
Schedule 3 May be available for "Domestic" purposes if so registered.
Schedule 4 "Domestic" products only.
Schedule 5 Limited to application on agricultural land.
Schedule 6 Similar to schedule 4 but may be registered for agricultural/commercial use.

For further information on the regulatory aspects of the classification please contact the Ministry of the Environment office nearest you. See page 3.

TABLE 19. PESTICIDES USED TO PROTECT FRUIT CROPS

a - acaricide, miticide
b - bactericide
i - insecticide
f - fungicide
n - nematicide
h - herbicide
r - rodenticide

Common or Chemical Name		Brand or Trade Name
anilazine	f	Dyrene
azinphos methyl	i	APM, Guthion
benomyl	f	Benlate
blue stone	bf	copper sulfate
borax	f	sodium tetraborate deca-hydrate
bordeaux	f	prepared in spray tank copper sulfate, hydrated lime and water
captan	f	Captan, Orthocide
captafol	f	Difolatan
carbaryl	i	Sevin
chinomethionat	af	Morestan
chlordane	i	Chlordane
copper sulfate	bf	bluestone
cyhexatin	a	Plictran
cypermethrin	i	Ripcord
deltamethrin	i	Decis
demeton	ai	Systox
diazinon	i	Basudin, Diazinon
1, 3 dichloropropene	n	Telone IIB
1, 3 dichloropropene + chloropicrin + methyl isothiocyanate	bifnh	Vorlex Plus CP
1, 3 dichloropropene + methyl isothiocyanate	bifnh	Vorlex Plus
dichlone	f	Phygon-XL, Dichlone
dichloran	f	Botran
dicofol	a	Kelthane
dimethoate	i	Cygon
dinocap	af	Karathane
diphacinone	r	Ramik Brown
DNOC	f	Elgetol
dodine	f	Cyprex, Equal
endosulfan	i	Thiodan
fenvalarate	i	Belmark
ferbam	f	Ferbam
fixed copper	b	various formulations
folpet	f	Phaltan
formetanate hydrochloride	a	Carzol
iprodione	f	Rovral
malathion	i	Malathion
mancozeb	f	Dithane M45, Manzate 200
maneb	f	Dithane M22, Manzate D, Mantox
metalaxyl	f	Ridomil
metaldehyde		metaldehyde
metam sodium	bifnh	Vapam
methidathion	i	Supracide
metiram	f	Polyram
methomyl	i	Lannate
methoxychlor	i	Marlate
mevinphos	i	Phosdrin
oxamyl	in	Vydate
oil	ai	oil
parathion	i	Parathion
permethrin	i	Ambush, Pounce
phosalone	i	Zolone
phosmet	i	Imidan
pirimicarb	i	Pirimor
propargite	a	Omite
rotenone	i	Rotenone
streptomycin sulfate	b	Agri-Mycin 17
sulfur	f	sulfur
thiram	f	Thiram
triforine	f	Funginex
zineb	f	Dithane Z-78
zinc phosphide	r	various formulations

OTHER INFORMATION FOR THE COMMERCIAL FRUIT PRODUCERS

The following information, dealing with fruit production in Ontario, likely is available at your local office:

Ontario Ministry of Agriculture and Food

Factsheets

070	Public and Farm Weather — Forecasting & Terminology
079	The Behavior of Frost in Ontario
200/691	Effects of Air Pollution on Agricultural Crops
200/842	Facts About the Ontario Food Terminal
202/65	Storage Incompatibility
202/744	Improving Spray Coverage on Row Crops
206/532	Leaf Analysis for Fruit Crops
206/532	Nutrient Deficiency Symptoms in Fruit Crops
206/564	Trickle Irrigation for Fruit Crops
210	Winter Injury in Fruit Trees
210/07	Critical Temperatures for Fruit Blossoms
210/11	Predicting Blossom Time in the Niagara Peninsula
210/24	Orchard Grafting Methods
210/24	Repair Grafting
210/24	Rules for Pruning Fruit Trees
210/24	Thinning Tree Fruits
210/24	Growth Regulators in the Orchard
210/63	Temporary Spring Storage of Young Fruit Trees
210/601	Metrics for Agriculture — Orchards and Vineyard Pesticides
210/628	Root-Lesion Nematode in Ontario Orchards
211/10	Growing Delicious Apples in Ontario
211/24	Pruning Oversize Spy Apple Trees
211/36	Apple Rootstocks
211/36	Managing Apple Trees on the M.26 Rootstock
211/65	Oxygen Pulldown Time in CA Storage
211/75	Frozen Apples
211/634	Cedar Apple Rust and Quince Rust
211/634	Fireblight of Apple and Pear
211/634	Pin-Point Scab of Apples
211/634	Blister Spot of Apples
211/634	Bitter-Pit Control in Apples
212/33	Peach Variety Identification
212/600	Pest Management Program in Peaches
212/623	Scale Insects on Peaches
212/624	Oriental Fruit Moth
212/624	Oblique-Banded Leaf Roller
212/624	Mite Pests of Peach
212/624	Plum Curculio
212/624	Peach Tree Borers
212/624	Comstock Mealy Bug on Peach
212/632	Pest Management Program for Grapes
212/634	Bacterial Spot of Peach
212/634	Black Knot of Plums and Cherries
212/634	Peach Canker in Ontario
212/634	Peach Leaf Curl
212/634	Pest Management Program for Peach Series — Tarnished Plant Bug
212/634	Pest Management Program for Peach Series — Brown Rot
212/634	X-Disease of Peach
214/11	Growing Apricots
215/634	Pear Psylla in Ontario Pear Orchards
230/601	Metrics for Agriculture — Berry Crop Pesticides
230/605	Insects and Diseases of Cane Fruits
231/24	Bunch — Thinning and Suckering Grapes
231/24	High-Corden Trellising Systems for Grapes
231/624	Grape Berry Moth on the Niagara Peninsula
236/12	Currants and Gooseberries
238/10	Elderberries
606	Soil Fumigants
607	Farm Storage of Pesticides
607	Pesticide Drift
607	Pesticide Container Rinsing
607	Pesticide Contamination of Farm Water Supplies
607	Protective Clothing When Using Pesticides Outdoors
628	Soil and Root Sampling for Nematode Analysis
628	Nematode Control — Guidelines for the Application of Soil Fumigants

OMAF Publications

75	Guide to Chemical Weed Control
431	Harvesting, Storing, and Packing Apples
505	Ontario Weeds — For Sale Only, $2.50
528	Planning and Planting the Orchard

Agriculture Canada

1762	Cultivating Red Raspberries in Eastern Canada

THE METRIC SYSTEM

Linear Measures (length)

10 millimetres (mm) = 1 centimetre (cm)
100 centimetres (cm) = 1 metre (m)
1000 metres = 1 kilometre (km)

Square Measures (area)

100 m × 100 m = 10,000 m^2 = 1 hectare (ha)
100 ha = 1 square kilometre (km^2)

Cubic Measures (volume)

Dry Measure

1000 cubic millimetres (mm^3) = 1 cubic centimetre (cm^3)
1,000,000 cm^3 = 1 cubic metre (m^3)

Liquid Measure

1000 millilitres (mL) = 1 litre (L)
100 L = 1 hectolitre (hL)

Weight — Volume Equivalents

(1.00 kg) 1000 grams = 1 litre (1.00 L)
(0.50 kg) 500 g = 500 mL (0.50 L)
(0.10 kg) 100 g = 100 mL (0.10 L)
(0.01 kg) 10 g = 10 mL (0.01 L)
(0.001 kg) 1 g = 1 mL (0.001 L)

Weight Measures

1000 milligrams (mg) = 1 gram (g)
1000 g = 1 kilogram (kg)
1000 kg = 1 tonne (t)
1 mg/kg = 1 part per million (ppm)

Dry — Liquid Equivalents

1 cm^3 = 1 mL
1 m^3 = 1000 L

METRIC EQUIVALENTS

LENGTH

inch = 2.54 cm
foot = 0.30 m
yard = 0.91 m
mile = 1.61 km

AREA

square foot = 0.09 m^2
square yard = 0.84 m^2
acre = 0.40 ha

WEIGHT

ounce = 28.35 g
pound = 453.6 g
ton = 0.91 tonne

PRESSURE

pound per square inch = 6.90 kPa

VOLUME (dry)

cubic yard = 0.76 m^3
bushel = 36.37 L

VOLUME (liquid)

fluid ounce (Imp.) = 28.41 mL
pint (Imp.) = 0.57 L
gallon (Imp.) = 4.55 L
gallon (U.S.) = 3.79 L

TEMPERATURE

°F = (°C × 9/5) + 32
°C = (°F − 32) × 5/9

Approximate Application Rate Conversions

Metric to Imperial

litres per hectare × 0.09 = gallons per acre
litres per hectare × 0.36 = quarts per acre
litres per hectare × 0.71 = pints per acre
millilitres per hectare × 0.015 = fluid ounces per acre
grams per hectare × 0.015 = ounces per acre
kilograms per hectare × 0.89 = pounds per acre
tonnes per hectare × 0.45 = tons per acre

Imperial to Metric

gallons per acre × 11.23 = litres per hectare (L/ha)
quarts per acre × 2.8 = litres per hectare (L/ha)
pints per acre × 1.4 = litres per hectare (L/ha)
fluid ounces per acre × 70 = millilitres per hectare (mL/ha)
tons per acre × 2.24 = tonnes per hectare (t/ha)
pounds per acre × 1.12 = kilograms per hectare (kg/ha)
ounces per acre × 70 = grams per hectare (g/ha)

CONVERSION TABLES — METRIC TO IMPERIAL

approximate

Length

1 millimetre (mm) = 0.04 inch
1 centimetre (cm) = 0.40 inch
1 metre (m) = 39.40 inches
1 metre (m) = 3.28 feet
1 metre (m) = 1.09 yards
1 kilometre = 0.62 mile

Volume (liquid)

1 millilitre (mL) = 0.035 fluid ounce
1 litre (L) = 1.76 pints
1 litre (L) = 0.88 quart
1 litre (L) = 0.22 gallon (Imperial)
1 litre (L) = 0.26 gallon (U.S.)

Weight

1 gram (g) = 0.035 ounce
1 kilogram (kg) = 2.21 pounds
1 tonne (t) = 1.10 short tons
1 tonne (t) = 2205 pounds

Pressure

1 kilopascal (kPa) = 0.15 pounds/square inch

Proportion

1 litre per hectare = 14.24 fluid ounces per acre
1 kilogram per hectare = 14.50 ounces avdp per acre
1 kilogram per square centimetre = 14.23 pounds per square inch
1 hectolitre per hectare = 1.10 bushels per acre

Area

1 square centimetre (cm^2) = 0.16 square inch
1 square metre (m^2) = 10.77 square feet
1 square metre (m^2) = 1.20 square yards
1 square kilometre (km^2) = 0.39 square mile
1 hectare (ha) = 107,636 square feet
1 hectare (ha) = 2.5 acres

Volume (dry)

1 cubic centimetre (cm^3) = 0.061 cubic inch
1 cubic metre (m^3) = 1.31 cubic yards
1 cubic metre (m^3) = 35.31 cubic feet
1000 cubic metres (m^3) = 0.81 acre-foot
hectolitre (hL) = 2.8 bushels

Speed

1 metre per second = 3.28 feet per second
1 metre per second = 2.24 miles per hour
1 kilometre per hour = 0.62 mile per hour

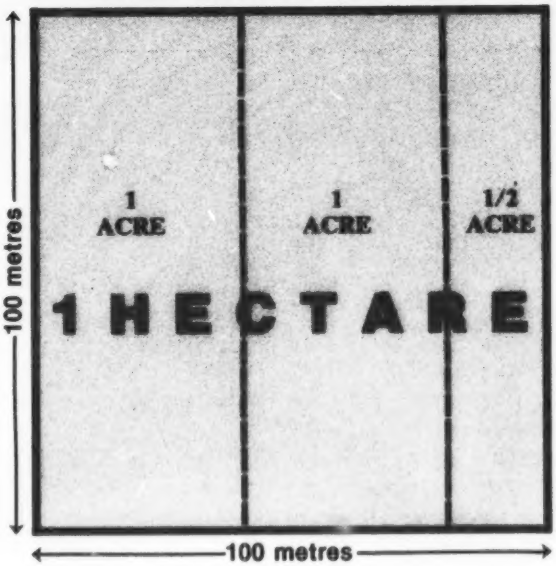
Temperature

°F = (°C × 9/5) + 32
°C = (°F − 32) × 5/9

ACRES TO HECTARES

1 acre = 0.4 hectares
2 acres = 0.8 hectares
3 acres = 1.2 hectares
4 acres = 1.6 hectares
5 acres = 2.0 hectares
6 acres = 2.4 hectares
7 acres = 2.8 hectares
8 acres = 3.2 hectares
9 acres = 3.6 hectares
10 acres = 4.0 hectares
20 acres = 8.0 hectares
30 acres = 12.0 hectares
40 acres = 16.0 hectares
50 acres = 20.0 hectares
60 acres = 24.0 hectares
70 acres = 28.0 hectares
80 acres = 32.0 hectares
90 acres = 36.0 hectares
100 acres = 40.0 hectares

ACRES BECOME HECTARES



100 m × 100 m = 10,000 m² = 1 hectare (ha)

HECTARES TO ACRES

1 hectare = 2.5 acres
2 hectares = 5.0 acres
3 hectares = 7.4 acres
4 hectares = 10.0 acres
5 hectares = 12.4 acres
6 hectares = 15.0 acres
7 hectares = 17.3 acres
8 hectares = 20.0 acres
9 hectares = 22.2 acres
10 hectares = 25.0 acres
20 hectares = 50.0 acres
30 hectares = 74.0 acres
40 hectares = 100.0 acres
50 hectares = 123.5 acres

METRIC APPLICATION RATES WITH AN ACRE PERSPECTIVE

Dry Weight

10 g/ha = 4 g/acre
20 g/ha = 8 g/acre
30 g/ha = 12 g/acre
40 g/ha = 16 g/acre
50 g/ha = 20 g/acre
100 g/ha = 40 g/acre
500 g/ha = 200 g/acre
1000 g/ha = 400 g/acre
1 kg/ha = 400 g/acre (0.4 kg/acre)
2 kg/ha = 800 g/acre (0.8 kg/acre)
3 kg/ha = 1.2 kg/acre
4 kg/ha = 1.6 kg/acre
5 kg/ha = 2 kg/acre
10 kg/ha = 4 kg/acre
20 kg/ha = 8 kg/acre
30 kg/ha = 12 kg/acre
40 kg/ha = 16 kg/acre
50 kg/ha = 20 kg/acre
100 kg/ha = 40 kg/acre
500 kg/ha = 200 kg/acre
1000 kg/ha = 400 kg/acre
1 tonne/ha = 400 kg/acre

Liquid Volume

10 mL/ha = 4 mL/acre
20 mL/ha = 8 mL/acre
30 mL/ha = 12 mL/acre
40 mL/ha = 16 mL/acre
50 mL/ha = 20 mL/acre
100 mL/ha = 40 mL/acre
500 mL/ha = 200 mL/acre
1000 mL/ha = 400 mL/acre
1 L/ha = 400 mL/acre (0.4 L/acre)
2 L/ha = 800 mL/acre (0.8 L/acre)
3 L/ha = 1.2 L/acre
4 L/ha = 1.6 L/acre
5 L/ha = 2 L/acre
10 L/ha = 4 L/acre
20 L/ha = 8 L/acre
30 L/ha = 12 L/acre
40 L/ha = 16 L/acre
50 L/ha = 20 L/acre
100 L/ha = 40 L/acre
500 L/ha = 200 L/acre
1000 L/ha = 400 L/acre

CROP OR FIELD NO.	DATE	MATERIAL USED	RATE AND AMOUNT	WEATHER AND SOIL CONDITIONS